

Troubleshooting

1104E and 1106E Industrial Engines

RF1 (Engine)
RH1 (Engine)
RK1 (Engine)
VK1 (Engine)

Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the "Safety Alert Symbol" and followed by a "Signal Word" such as "DANGER", "WARNING" or "CAUTION". The Safety Alert "WARNING" label is shown below.



The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by "NOTICE" labels on the product and in this publication.

Perkins cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. If a tool, procedure, work method or operating technique that is not specifically recommended by Perkins is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Perkins dealers or Perkins distributors have the most current information available.



When replacement parts are required for this product Perkins recommends using Perkins replacement parts.

Failure to heed this warning can lead to premature failures, product damage, personal injury or death.

Table of Contents

Troubleshooting Section

Electronic Troubleshooting

System Overview	5
Glossary	9
Electronic Service Tools	12
Indicator Lamps	14
Replacing the ECM	16
Self-Diagnostics	17
Sensors and Electrical Connectors	18
Engine Wiring Information	22

Programming Parameters

Programming Parameters	31
Factory Passwords	31
Flash Programming	31

System Configuration Parameters

System Configuration Parameters	33
---------------------------------------	----

Troubleshooting without a Diagnostic Code

Alternator Noise (Noisy Operation)	34
Alternator Will Not Charge (Charging Problem)	34
Battery	35
Can Not Reach Top Engine RPM	35
Coolant in Engine Oil	36
Coolant Temperature Is Too High	37
ECM Will Not Accept Factory Passwords	38
ECM Will Not Communicate with Other Systems or Display Modules	39
Electronic Service Tool Will Not Communicate with ECM	39
Engine Cranks but Will Not Start	40
Engine Has Early Wear	42
Engine Misfires, Runs Rough or Is Unstable	42
Engine Oil in Cooling System	44
Engine Stalls at Low RPM	45
Engine Vibration	46
Engine Will Not Crank	47
Excessive Black Smoke	48
Excessive Engine Oil Consumption	49
Excessive Valve Lash	51
Excessive White Smoke	51
Intake Air Temperature Is Too High	52
Intermittent Engine Shutdown	53
Intermittent Low Power or Power Cutout	54
Low Engine Oil Pressure	56
Low Power/Poor or No Response to Throttle	57
Mechanical Noise (Knock) in Engine	59
Noise Coming from Cylinder	60

Troubleshooting with a Diagnostic Code

Diagnostic Code Cross Reference	61
CID 0041 FMI 03	62
CID 0041 FMI 04	63
CID 0091 FMI 02	63
CID 0091 FMI 03	64
CID 0091 FMI 04	64
CID 0091 FMI 08	65

CID 0091 FMI 12	65
CID 0100 FMI 03	66
CID 0100 FMI 04	66
CID 0100 FMI 10	66
CID 0102 FMI 03	67
CID 0102 FMI 04	67
CID 0102 FMI 10	68
CID 0105 FMI 03	68
CID 0105 FMI 04	68
CID 0110 FMI 03	69
CID 0110 FMI 04	69
CID 0174 FMI 02	69
CID 0247 FMI 09	70
CID 0253 FMI 02	70
CID 0262 FMI 03	70
CID 0262 FMI 04	71
CID 0320 FMI 02	71
CID 0320 FMI 11	71
CID 0342 FMI 02	72
CID 0774 FMI 02	72
CID 0774 FMI 03	73
CID 0774 FMI 04	73
CID 0774 FMI 08	74
CID 0774 FMI 12	74
CID 1627 FMI 03	75
CID 1684 FMI 00	75
CID 1684 FMI 02	76
CID 1684 FMI 03	76
CID 1684 FMI 04	77
CID 1684 FMI 05	77
CID 1684 FMI 07	77
CID 1684 FMI 08	78
CID 1684 FMI 09	78
CID 1684 FMI 10	79
CID 1684 FMI 11	80
CID 1684 FMI 12	80
CID 1684 FMI 14	81
CID 1743 FMI 02	81
CID 1894 FMI 02	82
CID 1895 FMI 02	82

Troubleshooting with an Event Code

Event Codes	83
E015 High Engine Coolant Temperature Derate ..	83
E016 High Engine Coolant Temperature Shutdown	83
E017 High Engine Coolant Temperature Warning	83
E025 High Inlet Air Temperature Derate	84
E027 High Inlet Air Temperature Warning	84
E040 Low Engine Oil Pressure Shutdown	85
E054 High Fuel Temperature Derate	85
E056 High Fuel Temperature Warning	86
E100 Low Engine Oil Pressure Warning	87
E190 Engine Overspeed Warning	88

Diagnostic Functional Tests

5 Volt Engine Pressure Sensor Supply Circuit - Test	89
Air Inlet Heater Circuit - Test	93
Analog Throttle Position Sensor Circuit - Test	98
CAN Data Link Circuit - Test	103
Data Link Circuit - Test	111

Digital Throttle Position Sensor Circuit - Test	119
Electrical Connectors - Inspect	125
Electrical Power Supply Circuit - Test	134
Engine Pressure Sensor Open or Short Circuit - Test	139
Engine Temperature Sensor Open or Short Circuit - Test	145
Fuel Injection Pump Circuit - Test	149
Indicator Lamp Circuit - Test	159
Mode Selection Circuit - Test	162
Set Speed Circuit - Test	166
Speed/Timing Sensor Circuit - Test	171
Throttle Switch Circuit - Test	174

Index Section

Index	180
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Troubleshooting Section

Electronic Troubleshooting

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System Overview

System Operation

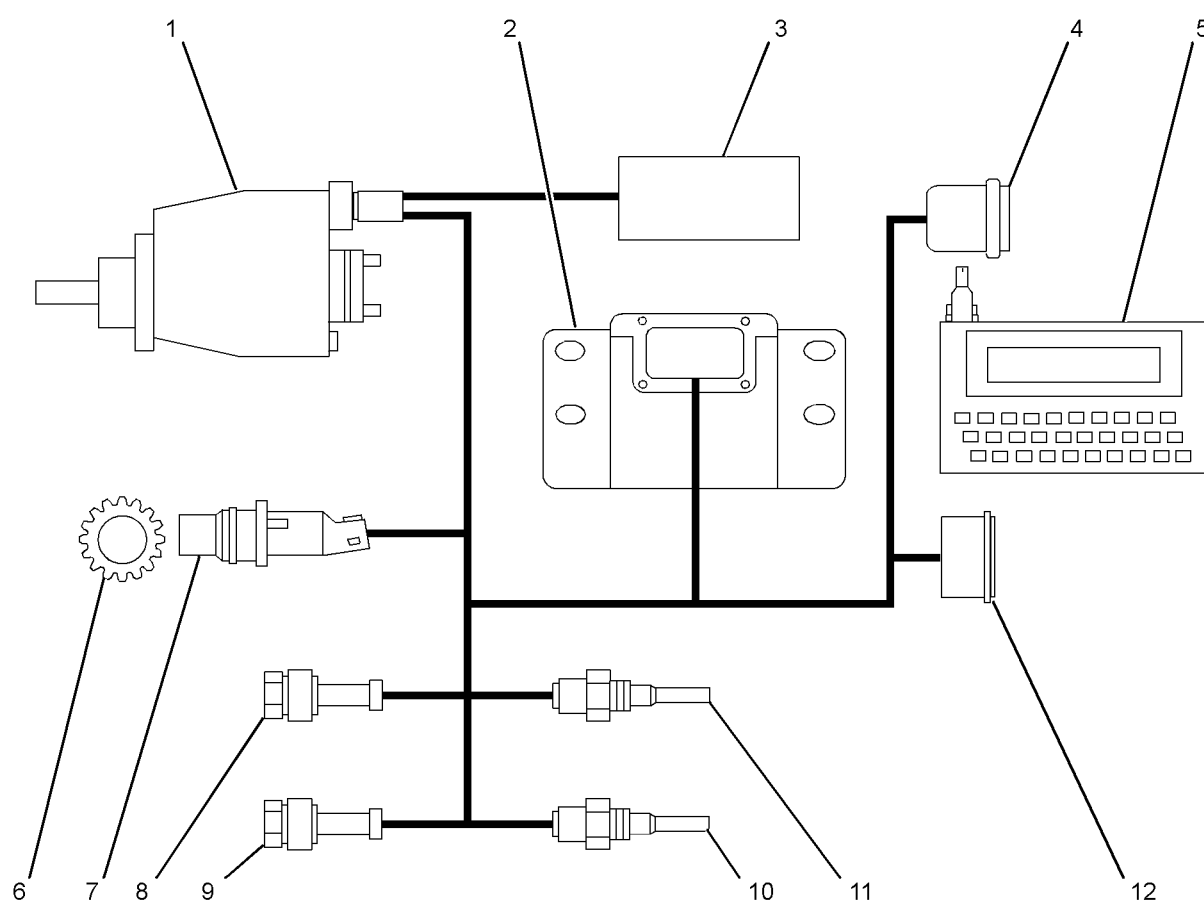


Illustration 1

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Schematic diagram of the fuel system

- | | | |
|---|-------------------------------------|---|
| (1) Fuel injection pump | (5) Electronic service tool | (9) Engine oil pressure sensor |
| (2) Electronic Control Module (ECM) | (6) 36 -1 tooth crankshaft gear | (10) Intake manifold air temperature sensor |
| (3) Voltage Load Protection Module (VLPM) | (7) Speed/timing sensor | (11) Engine coolant temperature sensor |
| (4) Diagnostic connector | (8) Intake manifold pressure sensor | (12) Machine interface connector |

The 1104 models RF, RH, RK and 1106 model VK engines were designed for electronic control. The engines include an Electronic Control Module (ECM), a fuel injection pump that is electronically controlled, and various engine sensors. The ECM controls the engine operating parameters through the software within the ECM and the inputs from the sensors. The software contains parameters that control the engine operation. The parameters include all of the operating maps and customer selected parameters.

The electronic system consists of the Electronic Control Module (ECM), the engine sensors, and the Machine Interface Connector (MIC). The ECM is the computer. The flash file is the software for the computer. The flash file contains the operating maps. The operating maps define the following characteristics of the engine:

- Torque curves
- Engine speed (rpm)
- Fuel injection timing

Electronic Controls

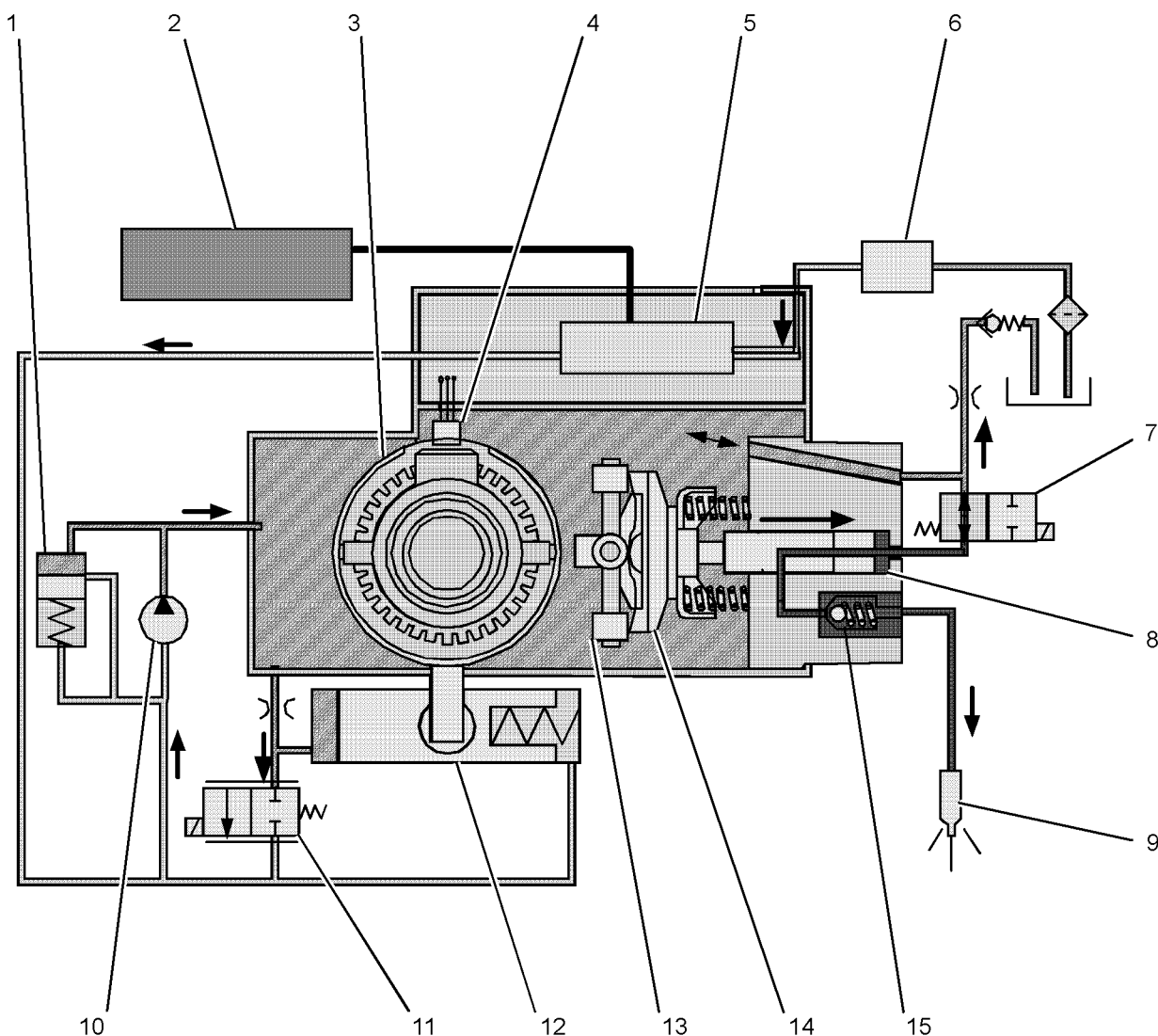


Illustration 2

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Schematic diagram of the fuel pump

- | | | |
|---|----------------------------|-------------------------------|
| (1) Pressure regulator | (6) Fuel lift pump | (12) Timing advance mechanism |
| (2) Electronic control module (ECM) | (7) Fuel solenoid valve | (13) Roller |
| (3) Cam ring | (8) Distributor plunger | (14) Cam plate |
| (4) Speed/timing sensor | (9) Fuel injector | (15) Delivery valve |
| (5) Electronic control unit for the fuel injection pump | (10) Fuel transfer pump | |
| | (11) Timing solenoid valve | |

Engine Governor

The ECM controls the injection timing and the amount of fuel that is delivered to the cylinders. The amount of fuel that is delivered by the fuel injection pump is based on the actual conditions and the desired conditions at any given time.

The governor compares the desired engine speed to the actual engine speed. The actual engine speed is determined through the primary speed/timing sensor and the secondary speed/timing sensor. If the desired engine speed is greater than the actual engine speed, the governor injects more fuel in order to increase engine speed. If the actual engine speed is greater than the desired engine speed, the governor reduces the amount of fuel that is supplied to the injectors in order to reduce engine speed.

Timing Considerations

Once the governor has calculated the amount of fuel that is required, the governor must determine the timing of the fuel injection. Fuel injection timing is controlled by the ECM after calculating inputs from the following components:

- Engine coolant temperature sensor
- The sensor for the intake manifold air temperature
- The sensor for the intake manifold pressure
- Speed/timing sensor

At start-up, the ECM determines the top center position of the number 1 cylinder from the speed/timing sensor in the fuel injection pump. The ECM calculates the time when fuel injection should occur relative to the top center position. The ECM provides the signal to the fuel solenoid valve in the fuel injection pump which stops fuel flow to the low pressure side. The fuel injection pump then forces fuel to flow to the fuel injectors at the desired time. The ECM adjusts timing for the best engine performance, the best fuel economy and the best control of exhaust emissions.

Fuel Injection

The flash file in the ECM sets certain limits on the amount of fuel that can be injected. The FRC Limit is a limit that is based on intake manifold pressure and engine speed. The FRC Limit is used to control the air/fuel ratio in order to control the engine's exhaust emissions. When the ECM senses a higher intake manifold pressure, the ECM increases the FRC Limit. A higher intake manifold pressure indicates that there is more air in the cylinder. When the ECM increases the FRC Limit, the ECM allows more fuel into the cylinder.

The Rated Fuel Limit is a limit that is based on the power rating of the engine and on the engine speed. The Rated Fuel Limit enables the engine power and torque outputs to conform to the power and torque curves of a specific engine model.

These limits are in the flash file and these limits cannot be changed.

Diagnostic Codes

When the ECM detects an electronic system fault, the ECM generates a diagnostic code. Also, the ECM logs the diagnostic code in order to indicate the time of the occurrence of the fault. The ECM also logs the number of occurrences of the fault. Diagnostic codes are provided in order to indicate that the ECM has detected an electrical fault or an electronic fault with the engine control system. In some cases, the engine performance can be affected when the condition that is causing the code exists.

If the operator indicates that a performance problem has occurred, the diagnostic code may indicate the cause of the fault. Use the electronic service tool to access the diagnostic codes. The fault should then be corrected.

Event Codes

Event Codes are used to indicate that the ECM has detected an abnormal engine operating condition. The ECM will log the occurrence of the event code. This does not indicate an electrical malfunction or an electronic malfunction. For example, if the temperature of the coolant in the engine is higher than the permitted limit, then the ECM will detect the condition. The ECM will then log an event code for the condition.

Programmable Parameters

Certain parameters that affect the engine operation may be changed with electronic service tools. The parameters are stored in the ECM and certain parameters are protected from unauthorized changes by passwords. These parameters are System Configuration Parameters.

System Configuration Parameters are set at the factory. System Configuration Parameters can affect emissions or power ratings within the engine. Factory passwords must be obtained and factory passwords must be used to change the System Configuration Parameters.

Passwords

Certain System Configuration Parameters can be protected by factory passwords. Factory passwords are calculated on a computer system that is available only to Perkins distributors. Since factory passwords contain alphabetic characters, only an electronic service tool may change System Configuration Parameters. System Configuration Parameters can affect the power rating or the emissions.

Refer to Troubleshooting, "Programming Parameters" and Troubleshooting, "Factory Passwords".

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Glossary

Active Diagnostic Code – An active diagnostic code alerts the operator or the service technician that an electronic system malfunction is currently present. Refer to the term “Diagnostic Code” in this glossary.

Alternating Current (AC) – Alternating current is an electric current that reverses direction at a regular interval that is reoccurring.

Before Top Center (BTC) – BTC is the 180 degrees of crankshaft rotation before the piston reaches the top center position in the normal direction of rotation.

Breakout Harness – The breakout harness is a test harness that is designed to connect into the engine harness. This connection allows a normal circuit operation and the connection simultaneously provides a Breakout T in order to measure the signals.

Bypass Circuit – A bypass circuit is a circuit that is used as a substitute circuit for an existing circuit. A bypass circuit is typically used as a test circuit.

CAN Data Link – The CAN Data Link is a serial communications port that is used for communication with other microprocessor based devices. In this application, the CAN Data Link connects the ECM to the Electronic Fuel Injection Pump.

Code – Refer to “Diagnostic Code” or “Event Code”.

Cold Mode – Cold mode is a mode for cold starting and for cold engine operation that includes timing that is retarded and low idle that is raised. This mode is used for engine protection, reduced smoke emissions and faster warm up time.

Communication Adapter Tool – The communication adapter provides a communication link between the ECM and the electronic service tool.

Component Identifier (CID) – The CID is a number that identifies the specific component of the electronic control system that has experienced a diagnostic code.

Coolant Temperature Sensor – The coolant temperature sensor detects the engine coolant temperature for cold mode operation and for Engine Monitoring.

Data Link – The Data Link is a serial communication port that is used for communication with other microprocessor based devices.

Desired Engine Speed – The desired engine speed is input to the electronic engine speed governor within the ECM. The electronic governor uses the signal from the throttle position sensor, the engine speed/timing sensor, and other sensors in order to determine the desired engine speed.

Diagnostic Code – A diagnostic code is sometimes referred to as a fault code. These codes indicate an electronic system malfunction.

Diagnostic Lamp – A diagnostic lamp is sometimes called the check engine light. The diagnostic lamp is used to warn the operator of the presence of an active diagnostic code. The lamp may not be included in all applications.

Digital Sensor Return – The common line (ground) from the ECM is used as ground for the digital sensors.

Digital Sensors – Digital sensors produce a pulse width modulated signal. Digital sensors are supplied with power from the ECM.

Digital Sensor Supply – The power supply from the ECM is used in order to power the digital sensors.

Direct Current (DC) – Direct current is the type of current that flows consistently in only one direction.

DT, DT Connector, or Deutsch DT – This is a type of connector that is used on Perkins engines. The connectors are manufactured by Deutsch.

Duty Cycle – Refer to “Pulse Width Modulation”.

Electronic Engine Control – The electronic engine control is a complete electronic system. The electronic engine control monitors the engine operation under all conditions. The electronic engine control also controls the engine operation under all conditions.

Electronic Control Module (ECM) – The ECM is the control computer of the engine. The ECM provides power to the electronics. The ECM monitors data that is input from the sensors of the engine. The ECM acts as a governor in order to control the speed and the power of the engine.

Electronic Service Tool – The electronic service tool allows a computer (PC) to communicate with the ECM.

Engine Monitoring – Engine Monitoring is the part of the electronic engine control that monitors the sensors. This also warns the operator of detected problems.

Engine Oil Pressure Sensor – The engine oil pressure sensor measures engine oil pressure. The sensor sends the signal to the ECM.

Engine Speed/Timing Sensor – The engine speed/timing sensor provides a signal to the ECM that has variable amplitude and variable frequency. The ECM interprets this signal as the crankshaft position and the engine speed.

Event Code – An event code may be activated in order to indicate an abnormal engine operating condition. These codes usually indicate a mechanical problem instead of an electrical system problem.

Failure Mode Identifier (FMI) – This identifier indicates the type of failure that has been experienced by the component. The FMI has been adopted from the SAE practice of J1587 diagnostics. The FMI follows the parameter identifier (PID) in the descriptions of the fault code. The descriptions of the FMIs are in the following list.

0 – The data is valid but the data is above the normal operational range.

1 – The data is valid but the data is below the normal operational range.

2 – The data is erratic, intermittent, or incorrect.

3 – The voltage is above normal or the voltage is shorted high.

4 – The voltage is below normal or the voltage is shorted low.

7 – The mechanical system is not responding properly.

8 – There is an abnormal frequency, an abnormal pulse width, or an abnormal time period.

9 – There has been an abnormal update.

10 – There is an abnormal rate of change.

11 – The failure mode is not identifiable.

12 – The device or the component is damaged.

14 – There is a special instruction.

Flash File – This file is software that is inside the ECM. The file contains all the instructions (software) for the ECM and the file contains the performance maps for a specific engine. The file may be reprogrammed through flash programming.

Flash Programming – Flash programming is the method of programming or updating an ECM with an electronic service tool over the data link instead of replacing components.

Fuel Ratio Control (FRC) – The FRC is a limit that is based on the control of the ratio of the fuel to air. The FRC is used for purposes of emission control. When the ECM senses a higher intake manifold air pressure (more air into the cylinder), the FRC increases the FRC Limit (more fuel into the cylinder).

Fuel Temperature Sensor – The fuel temperature sensor detects the fuel temperature. The ECM monitors the fuel temperature and the ECM adjusts the calculated fuel rate accordingly.

Full Load Setting (FLS) – The FLS is the parameter that represents the fuel system adjustment. This adjustment is made at the factory in order to fine tune the fuel system. The correct value for this parameter is stamped on the engine information ratings plate. This parameter must be programmed.

Full Torque Setting (FTS) – The FTS is the parameter that represents the adjustment for the engine torque. This adjustment is made at the factory in order to fine tune the fuel system. This adjustment is made in conjunction with the FLS. This parameter must be programmed.

Harness – The harness is the bundle of wiring (loom) that connects all components of the electronic system.

Hertz (Hz) – Hertz is the measure of electrical frequency in cycles per second.

Intake Manifold Air Temperature Sensor – The intake manifold air temperature sensor detects the air temperature in the intake manifold. The ECM monitors the air temperature and other data in the intake manifold in order to adjust injection timing and other performance functions.

Intake Manifold Pressure Sensor – The air pressure in the intake manifold may be different to the air pressure outside the engine (atmospheric pressure). This difference in air pressure can be caused by variable air velocity within the manifold. The difference in pressure can also be caused by an increase in air pressure by a turbocharger (if equipped). The sensor for the intake manifold pressure measures the difference between atmospheric pressure and the air pressure in the intake manifold.

Integrated Electronic Controls – The engine is designed with the electronic controls as a necessary part of the system. The engine will not operate without the electronic controls.

J1939 CAN Data Link – This data link is a SAE diagnostic communications data link that is used to communicate between the ECM and the electronic service tool.

Logged Diagnostic Codes – Logged diagnostic codes are codes which are stored in the memory. These codes are meant to be an indicator of possible causes for intermittent faults. Refer to the term “Diagnostic Code” in this glossary for more information.

MAB – This is a Bosch acronym for the fuel shutoff inside the “VP30” Fuel Injection Pump. The MAB is a signal wire from the ECM to the Fuel Injection Pump.

Open Circuit – An open circuit is a condition that is caused by an open switch, or by an electrical wire or a connection that is broken. When this condition exists, the signal or the supply voltage can no longer reach the intended destination.

Parameter – A parameter is a value or a limit that is programmable. This helps determine specific characteristics or behaviors of the engine. A parameter can also show the status of a part of the system on the electronic service tool.

Password – A password is a group of numeric characters or a group of alphanumeric characters that is designed to restrict access to parameters. The electronic system requires correct passwords in order to change some parameters (Factory Passwords). Refer to Troubleshooting, “Factory Passwords” for more information.

Personality Module – See “Flash File”.

Power Cycled – Power cycled happens when power to the ECM is cycled: ON, OFF, and ON. Power cycled refers to the action of cycling the keyswitch from any position to the OFF position, and to the START/RUN position.

Pulse Width Modulation (PWM) – The PWM is a signal that consists of pulses that are of variable width. These pulses occur at fixed intervals. The ratio of “TIME ON” versus total “TIME OFF” can be varied. This ratio is also referred to as a duty cycle.

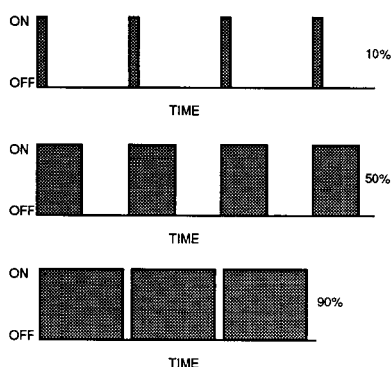


Illustration 3

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Rated Fuel Limit – This is a limit that is based on the power rating of the engine and on the engine rpm. The Rated Fuel Limit enables the engine power and torque outputs to conform to the power and torque curves of a specific engine model. These limits are in the flash file and these limits cannot be changed.

Reference Voltage – Reference voltage is a regulated voltage and a steady voltage that is supplied by the ECM to a sensor. The reference voltage is used by the sensor to generate a signal voltage.

Relay – A relay is an electromechanical switch. A flow of electricity in one circuit is used to control the flow of electricity in another circuit. A small current or voltage is applied to a relay in order to switch a much larger current or voltage.

Sensor – A sensor is a device that is used to detect a change in pressure, temperature, or mechanical movement. The information that is detected is converted into an electrical signal.

Short Circuit – A short circuit is a condition that has an electrical circuit that is inadvertently connected to an undesirable point. An example of a short circuit is a wire which rubs against a vehicle frame and this rubbing eventually wears off the wire insulation. Electrical contact with the frame is made and a short circuit results.

Signal – The signal is a voltage or a waveform that is used in order to transmit information typically from a sensor to the ECM.

Speed/Timing Sensor – This sensor determines the position of the crankshaft during engine operation. There is also a supplementary speed/timing sensor in the fuel pump that is used to provide a signal for the position of the crankshaft during engine starting.

Supply Voltage – The supply voltage is a continuous voltage that is supplied to a component in order to provide the electrical power that is required for the component to operate. The power may be generated by the ECM or the power may be battery voltage that is supplied by the engine wiring.

System Configuration Parameters – System configuration parameters are parameters that affect emissions and/or operating characteristics of the engine.

Tattletale – Certain parameters that affect the operation of the engine are stored in the ECM. These parameters can be changed by use of the electronic service tool. The tattletale logs the number of changes that have been made to the parameter. The tattletale is stored in the ECM.

Throttle Position – The throttle position is the interpretation by the ECM of the signal from the throttle position sensor or the throttle switch.

Throttle Position Sensor – The throttle position sensor is an electronic sensor that is connected to an accelerator pedal or a hand lever. This sensor sends a signal to the ECM that is used to calculate desired engine speed.

Throttle Switch – The throttle switch sends a signal to the ECM that is used to calculate desired engine speed.

Top Center Position – The top center position refers to the crankshaft position when the engine piston position is at the highest point of travel. The engine must be turned in the normal direction of rotation in order to reach this point.

Total Tattletale – The total tattletale is the total number of changes to all the parameters that are stored in the ECM.

Voltage Load Protection Module (“VLPM”) – The “VLPM” monitors the voltage of the electronic system. The “VLPM” will eliminate any high voltage conditions that occur. The “VLPM” will protect the fuel injection pump from any high voltage conditions that could damage the pump.

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Electronic Service Tools

Perkins electronic service tools are designed to help the service technician:

- Retrieve diagnostic codes.
- Diagnose electrical problems.
- Read parameters.
- Program parameters.
- Install trim files.

Required Service Tools

Table 1

Required Service Tools	
Part Number	Description
CH11155	Crimp Tool (12-AWG TO 18-AWG)
2900A019	Wire Removal Tool
-	Suitable Digital Multimeter

Two short jumper wires are needed to check the continuity of some wiring harness circuits by shorting two adjacent terminals together in a connector. A long extension wire may also be needed to check the continuity of some wiring harness circuits.

Optional Service Tools

Table 2 lists the optional service tools that can be used when the engine is serviced.

Table 2

Part Number	Description
U5MK1092	Spoon Probe Kit(MULTIMETER)
- or -	Suitable Digital Pressure Indicator or Engine Pressure Group
-	Suitable Battery Load Tester
-	Suitable Temperature Adapter (MULTIMETER)
-	Bypass Harness Assembly
-	Harness Assembly

Perkins Electronic Service Tool

The Perkins Electronic Service Tool can display the following information:

- Status of all pressure sensors and temperature sensors
- Programmable parameter settings
- Active diagnostic codes and logged diagnostic codes
- Logged events
- Histograms

The Electronic Service Tool can also be used to perform the following functions:

- Diagnostic tests
- Programming of flash files
- Parameter programming
- Copy configuration function for ECM replacement
- Data logging
- Graphs (real time)

Table 3 lists the service tools that are required in order to use the Electronic Service Tool.

Table 3

Service Tools for the Use of the Electronic Service Tool	
Part Number	Description
-(1)	Single Use Program License
-(1)	Data Subscription for All Engines
27610164 or 27610251	TIPSS Communication Adapter Kit (Electronic Service Tool to ECM interface) or Compact Communication Adapter Kit (Electronic Service Tool to ECM interface)

(1) Refer to Perkins Engine Company Limited.

Note: For more information regarding the use of the Electronic Service Tool and the PC requirements for the Electronic Service Tool, refer to the documentation that accompanies your Perkins Electronic Service Tool software.

Connecting the Electronic Service Tool and the TIPSS Communication Adapter

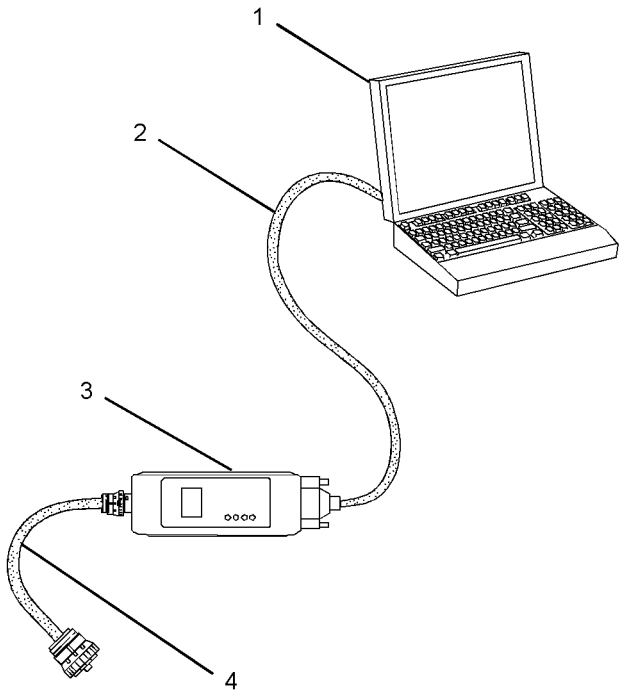


Illustration 4

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- (1) Personal Computer (PC)
- (2) Adapter Cable (Computer Serial Port)
- (3) TIPSS Communication Adapter
- (4) Adapter Cable Assembly

Note: Items (2), (3) and (4) are part of the TIPSS Communication Adapter Kit.

Use the following procedure in order to connect the Electronic Service Tool and the TIPSS Communication Adapter.

1. Turn the keyswitch to the OFF position.
2. Connect cable (2) between the “COMPUTER” end of TIPSS Communication Adapter (3) and the RS232 serial port of PC (1).

Note: The Adapter Cable Assembly (4) is required to connect to the USB port on computers that are not equipped with a RS232 serial port.

3. Connect cable (4) between the “DATA LINK” end of TIPSS Communication Adapter (3) and the service tool connector.
4. Place the keyswitch in the ON position. If the Electronic Service Tool and the TIPSS Communication Adapter do not communicate with the Electronic Control Module (ECM), refer to Troubleshooting, “Electronic Service Tool Will Not Communicate With ECM”.

Connecting the Electronic Service Tool and the Compact Communication Adapter

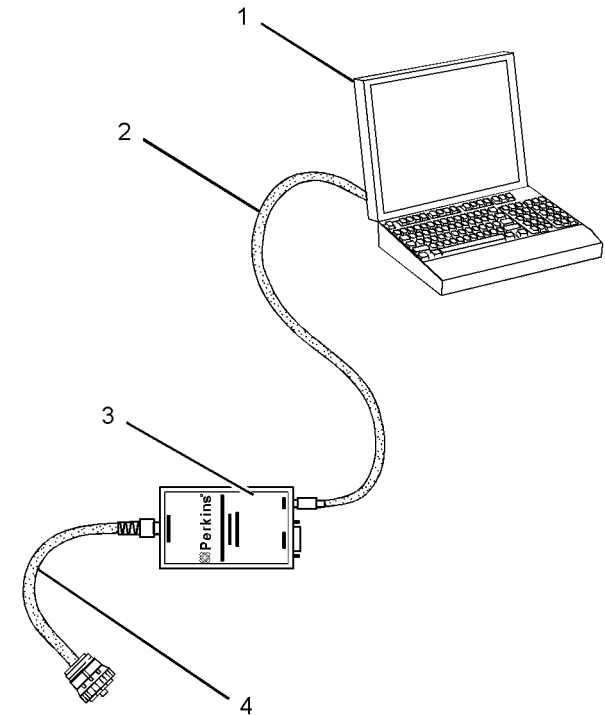


Illustration 5

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- (1) Personal Computer (PC)
- (2) Adapter Cable
- (3) Compact Communication Adapter
- (4) Compact Cable Assembly

Note: Items (2), (3) and (4) are part of the Compact Communication Adapter kit.

Use the following procedure in order to connect the Electronic Service Tool and the Compact Communication Adapter.

1. Turn the keyswitch to the OFF position.
2. Connect cable (2) between the "COMPUTER" end of compact communication adapter (3) and the USB port of PC (1).
3. Connect cable (4) between the "DATA LINK" end of compact communication adapter (3) and the service tool connector.
4. Place the keyswitch in the ON position. If the Electronic Service Tool and the compact communication adapter do not communicate with the Electronic Control Module (ECM), refer to Troubleshooting, "Electronic Service Tool Will Not Communicate With ECM".

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Indicator Lamps

Some engine applications are equipped with indicator lamps. Indicator lamps can be used as a diagnostic aid. There are two lamps. One lamp has an orange lens and the other lamp has a red lens.

These indicator lamps can be used in two ways:

- The indicator lamps can be used to identify the current operational status of the engine. The indicator lamps can also be used to indicate that the engine has a fault. This system is automatically operated via the ignition switch.
- The indicator lamps can be used to identify active diagnostic codes. This system is activated by pressing the Flash Code button.

Use the lamps to check the operational status of the engine or the existence of any engine faults.

Each lamp will be illuminated in a combination of ways in order to identify the engine's operational status. The lamps will also be illuminated in a combination of ways to indicate if the engine has a fault. These combinations of illuminated lamps have the following meanings:

The status of the lamps before the engine is cranked. This also acts as a lamp check.

When the ignition switch is turned ON, the lamps will be illuminated for 2 seconds. The lamps are then OFF unless the cold starting aid is required.

Table 4

Orange lamp (status)	Red lamp (status)	Comments
ON	ON	The lamps will be illuminated for 2 seconds or the lamps will be illuminated until the engine is cranked.
Refer to the comments.	OFF	The lamp will be OFF unless the cold starting aid is required.

The lamp status with the cold starting aid in operation and before the engine is cranked.

The orange lamp will be illuminated until the engine is ready to be cranked.

Table 5

Orange lamp (status)	Red lamp (status)	Comments
ON	OFF	The status of the lamps with the cold starting aid still operating.
Then OFF	OFF	This is the status of the lamps while the engine is being cranked. The cold starting aid is no longer operating.

This is the status of the lamps while the engine is being cranked.

Unless there is a fault, the engine monitoring system will not illuminate the indicator lamps while the engine is being cranked. For example if there is a lack of lubricating oil pressure after the start delay is exceeded. This type of fault will cause the stop lamp for the engine to be illuminated.

Table 6

Orange lamp (status)	Red lamp (status)	Comments
OFF	OFF	There are no apparent problems.
ON	ON	The lubricating oil pressure is low. This low oil pressure was measured after the set delay had expired.

The status of the lamps after cranking has failed to start the engine.

Table 7

Orange lamp (status)	Red lamp (status)	Comments
OFF	OFF	No faults were detected.
ON	OFF	An electrical fault was detected.
OFF	Flashing	The engine was activated when a serious fault was detected.

Other combinations of illuminated indicator lamp

The following combinations of lamp status may also be exhibited when the engine is either running or when the engine has been shut down automatically.

Table 8

Orange lamp (status)	Red lamp (status)	Comments
OFF	OFF	No faults were detected.
OFF	ON	The oil pressure is low.
Flashing	OFF	Either the coolant temperature is high or the intake air temperature is high. The engine may be derated.
OFF	Flashing	Either a fault has caused the engine to be automatically shut down or the engine has exceeded the condition for a derate.
ON	OFF	An electrical fault has been detected.
ON	ON	The oil pressure is low and there is an electrical fault.
ON	Flashing	Either a fault has caused the engine to shut down or the engine has exceeded the conditions for a derate. There is also an electrical fault.
Flashing	ON	The oil pressure is low and either the coolant temperature or the intake air temperature is high. The engine may be derated.

Use the lamps to identify active diagnostic codes.

The indicator lamps can be used to identify an active code by flashing in a sequence that will identify the active code. The active code that is flashed by the indicator lamps is related to the Component Identifier (CID). The indicator lamps cannot identify the fault with the component. The active code that is flashed by the indicator lamps is not a Failure Mode Identifier (FMI).

Table 9

CID number	Description	Flash code
0041	8 Volt DC Supply	517
0091	Throttle Position Sensor	154
0100	Engine Oil Pressure Sensor	157
0102	Boost Pressure Sensor	135
0105	Inlet Manifold Temperature Sensor	133
0110	Engine Coolant Temperature Sensor	168
0168	Electrical System Voltage	422
0174	Fuel Temperature Sensor	165
0247	SAE J1939 Data Link	514
0253	Personality Module	415
0262	5 Volt Sensor DC Power Supply	516
0320	Speed/Timing Sensor	141
0342	Secondary Engine Speed Sensor	142
0774	Secondary Throttle Position Sensor	155
1627	Fuel Pump Relay	187
1684	Fuel Injection Pump	158
1690	Throttle #2 Position Sensor	195
1743	Engine Operation Mode Selector Switch	144
1894	Cruise Control Disengage Switch	427
1895	Cruise Control Speed Toggle Switch	428

When the Flash Code feature is activated the indicator lamps will flash the codes of all active codes. Activation of the indicator lamps is achieved by cycling the keyswitch OFF and ON twice within 3 seconds.

There will be a delay of 2 seconds before the lamps start to flash the identity of any active code.

An active CID with two digits will be flashed in the following sequence. There will be a number of flashes. The number of flashes will equal the first digit. There will be a delay before a second number of flashes. The second number of flashes will equal the second digit. For example, a CID code of 41 will be four flashes, a delay and the one flash. A three digit CID code will have two delays between the sequence of flashes. A four digit CID code will have three delays between the sequence of flashes.

Each flash of the lamp will be 0.5 seconds long.

There will be a delay between each flash of 0.3 seconds.

Each delay between each digit of the code will be 2 seconds.

After one active code has been identified there will be a delay of 5 seconds before the next active code is flashed.

The sequence of flashing the active codes may be restarted at any time by reactivating the cycling of the keyswitch.

i02582961

Replacing the ECM

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

The engine is equipped with an Electronic Control Module (ECM). The ECM contains no moving parts. Follow the troubleshooting procedures in this manual in order to be sure that replacing the ECM will correct the fault. Verify that the suspect ECM is the cause of the fault.

Note: Ensure that the ECM is receiving power and that the ECM is properly grounded before replacement of the ECM is attempted. Refer to the Schematic Diagram.

Using a Test ECM

A test ECM can be used in order to determine if the ECM on the engine is faulty. Install a test ECM in place of the suspect ECM. Install the flash file into the test ECM. Program the parameters for the test ECM. The parameters must match the parameters in the suspect ECM. Refer to the following test steps for details. If the test ECM resolves the fault, reconnect the suspect ECM. Verify that the fault returns. If the fault returns, replace the ECM.

Use the Electronic Service Tool to read the parameters in the suspect ECM. Record the parameters in the suspect ECM. Install the flash file into the new ECM. After the ECM is installed on the engine, the parameters must be programmed into the new ECM.

Note: When a new ECM is not available, you may need to remove an ECM from an engine that is not in service. The ECM must have the same serial number suffix. Ensure that the replacement ECM and the flash file match the suspect ECM. Be sure to record the parameters from the replacement ECM. Use the "Copy Configuration ECM Replacement" function in the Electronic Service Tool.

NOTICE

If the flash file and engine application are not matched, engine damage may result.

Replacement of the ECM

Perform the following procedure in order to replace the ECM.

1. Connect the Electronic Service Tool to the diagnostic connector.
2. Use the "Copy Configuration ECM Replacement" function from the Electronic Service Tool. If the "Copy Configuration" is successful, proceed to Step 5. If the "Copy Configuration" failed, proceed to Step 3.

Note: Record any Logged Faults and Events for your records.

3. Record the following parameters:

- Record all of the parameters on the "Configuration" screen.
- Record all of the parameters on the "Throttle Configuration" screen.
- Record all of the parameters on the "Mode Configuration" screen.

Note: If the parameters cannot be read, the parameters must be obtained elsewhere. Some parameters are stamped on the engine information plate, but most parameters must be obtained from the PTMI data on Perkins Secured Internet.

4. Remove power from the ECM.
5. Remove the ECM. Refer to Disassembly and Assembly, "Electronic Control Module - Remove and Install".
6. Install the replacement ECM. Refer to Disassembly and Assembly, "Electronic Control Module - Remove and Install".
7. Download the flash file.
 - a. Connect the Electronic Service Tool to the diagnostic connector.
 - b. Select "WinFlash" from the "Utilities" menu of the electronic service tool.
 - c. Select the downloaded flash file.
8. If necessary, use the electronic service tool to clear the rating interlock. To clear the rating interlock, enter the factory password when the electronic service tool is first connected. Activating the "Test ECM" mode will also clear the rating interlock.
9. Use the electronic service tool to program the parameters. Perform the following procedure.
 - a. If the "Copy Configuration" procedure was successful, use the "Copy Configuration, ECM Replacement" function to load the configuration file into the ECM.

Note: During the following procedure, Factory Passwords may be required.

- b. If the "Copy Configuration" procedure failed, configure the parameters individually. The parameters should match the parameters from step 3.
10. Check for logged diagnostic codes. Factory passwords are required to clear Logged Events.

- Diagnostic
- Event

Diagnostic Code – When a fault in the electronic system is detected, the ECM generates a diagnostic code. This indicates the specific fault in the circuitry.

Diagnostic codes can have two different states:

- Active
- Logged

Active Code – An active diagnostic code indicates that an active fault has been detected. Active codes require immediate attention. Always service active codes prior to servicing logged codes.

Logged Code – Every generated code is stored in the permanent memory of the ECM. The codes are logged.

Event Code – An event code is generated by the detection of an abnormal engine operating condition. For example, an event code will be generated if the oil pressure is too low. In this case, the event code indicates the symptom of a fault.

Logged codes may not indicate that a repair is needed. The fault may have been temporary. The fault may have been resolved since the logging of the code. If the system is powered, it is possible to generate an active diagnostic code whenever a component is disconnected. When the component is reconnected, the code is no longer active. Logged codes may be useful to help troubleshoot intermittent faults. Logged codes can also be used to review the performance of the engine and the electronic system.

i02582997

Self-Diagnostics

The Electronic Control Module (ECM) has the ability to detect faults with the electronic system and with engine operation. When a fault is detected, a code is generated. An alarm may also be generated. There are two types of codes:

i02583003

Sensors and Electrical Connectors

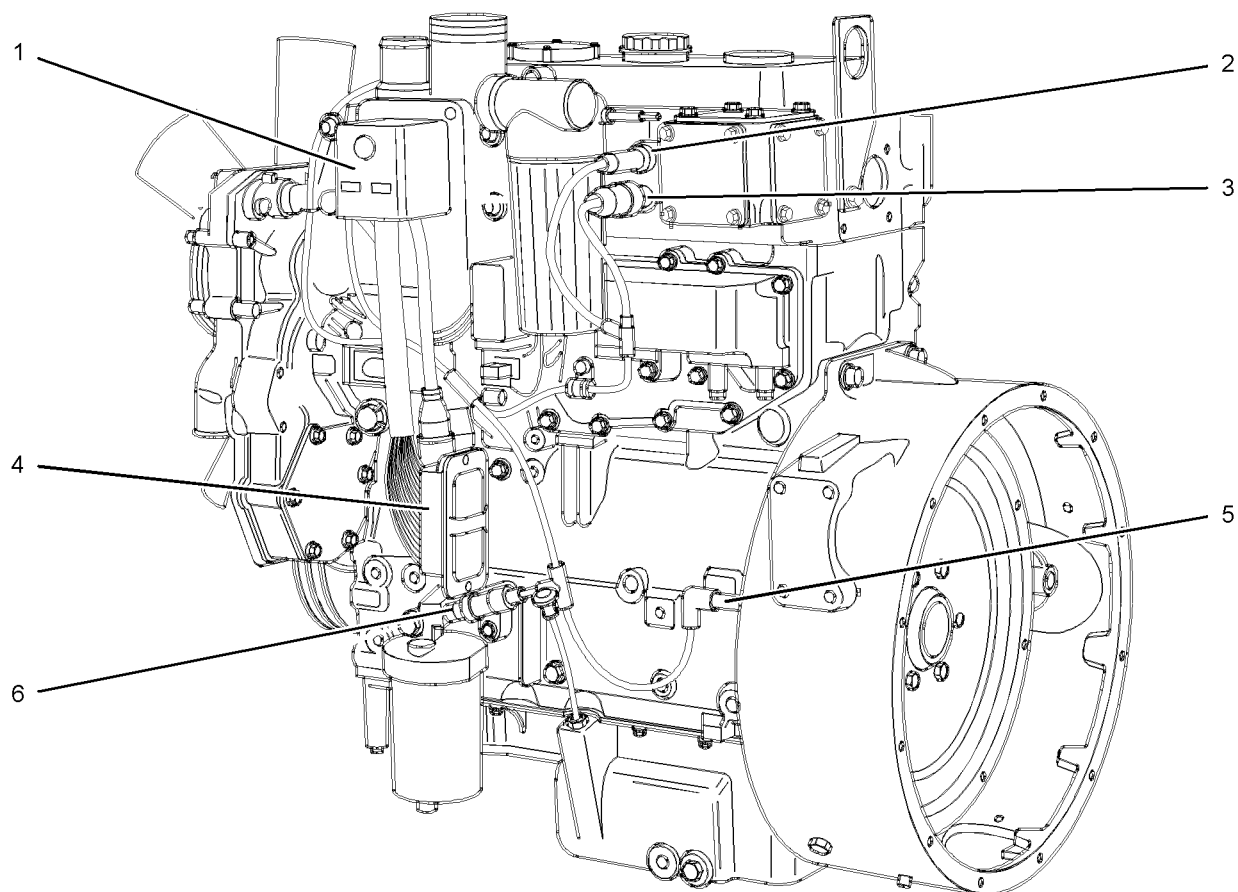


Illustration 6

g01293760

Sensor and connector locations on the left side of the 1104C engine

- | | | |
|--|---------------------------------------|--------------------------------|
| (1) Electronic Control Module (ECM) | (3) Intake manifold pressure sensor | (5) Engine speed/timing sensor |
| (2) Intake manifold air temperature sensor | (4) Machine Interface Connector (MIC) | (6) Engine oil pressure sensor |

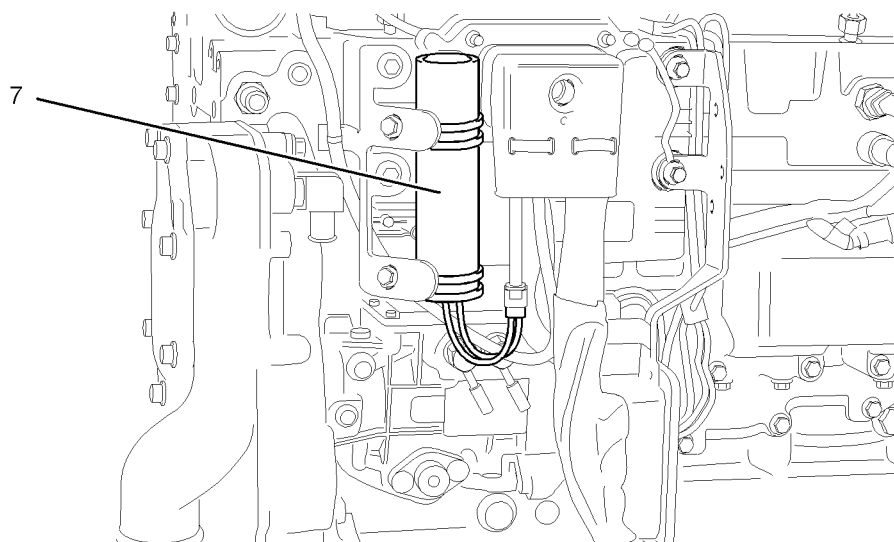


Illustration 7

g01293780

Typical location for the VLPM on the 1104C engine

(7) Voltage Load Protection Module (VLPM)

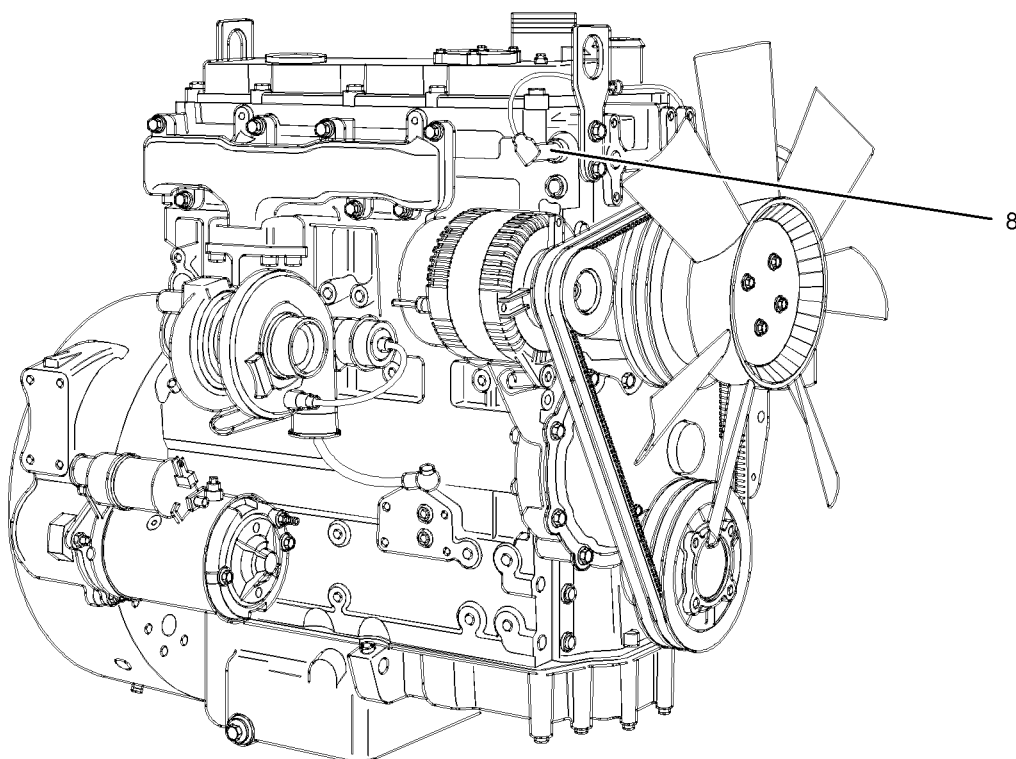


Illustration 8

g01293977

Sensor and connector locations on the right side of the 1104C engine

(8) Engine coolant temperature sensor

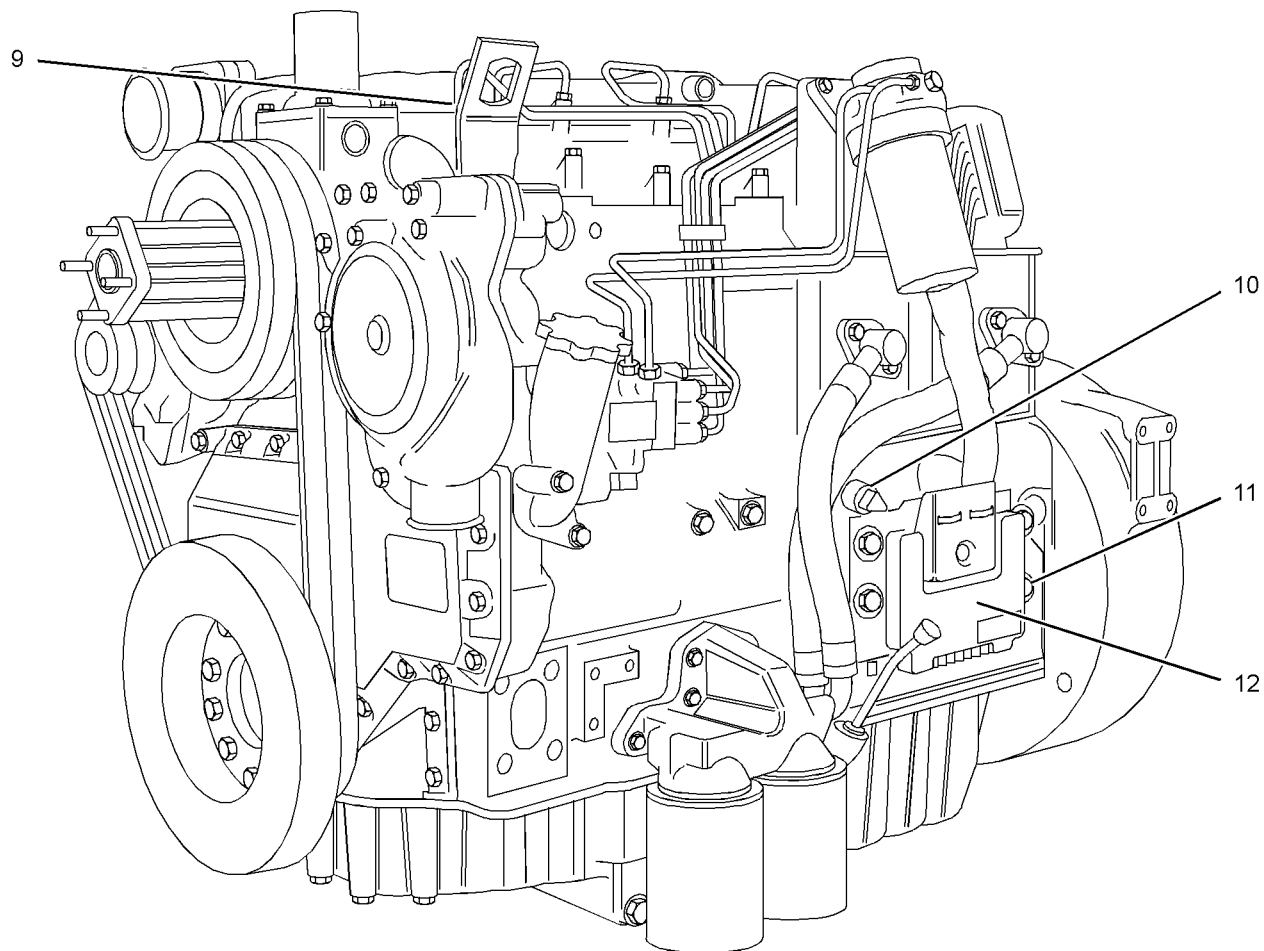


Illustration 9

g01293979

Sensor and connector locations on the left side of the 1106C engine

(9) Engine coolant temperature sensor
(10) Engine oil pressure sensor

(11) Engine speed/timing sensor
(12) Electronic Control Module (ECM)

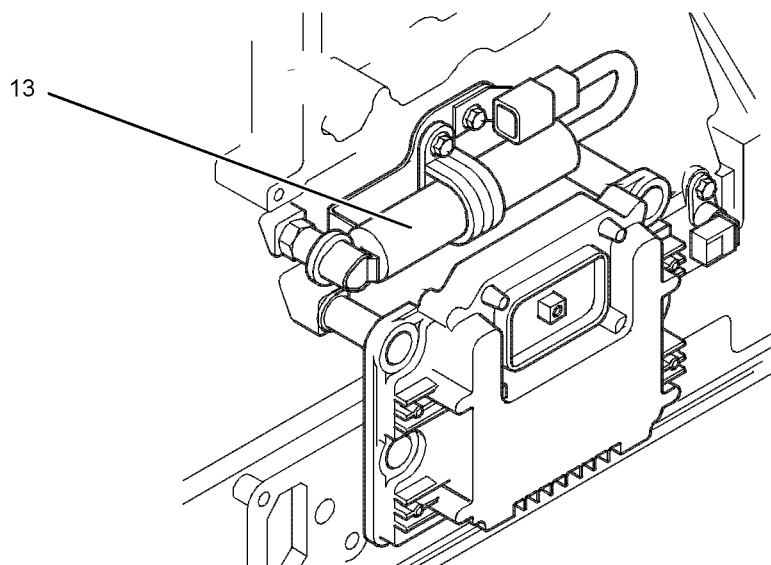


Illustration 10

g01293981

Typical location for the VLPM on the 1106C engine

(13) Voltage Load Protection Module (VLPM)

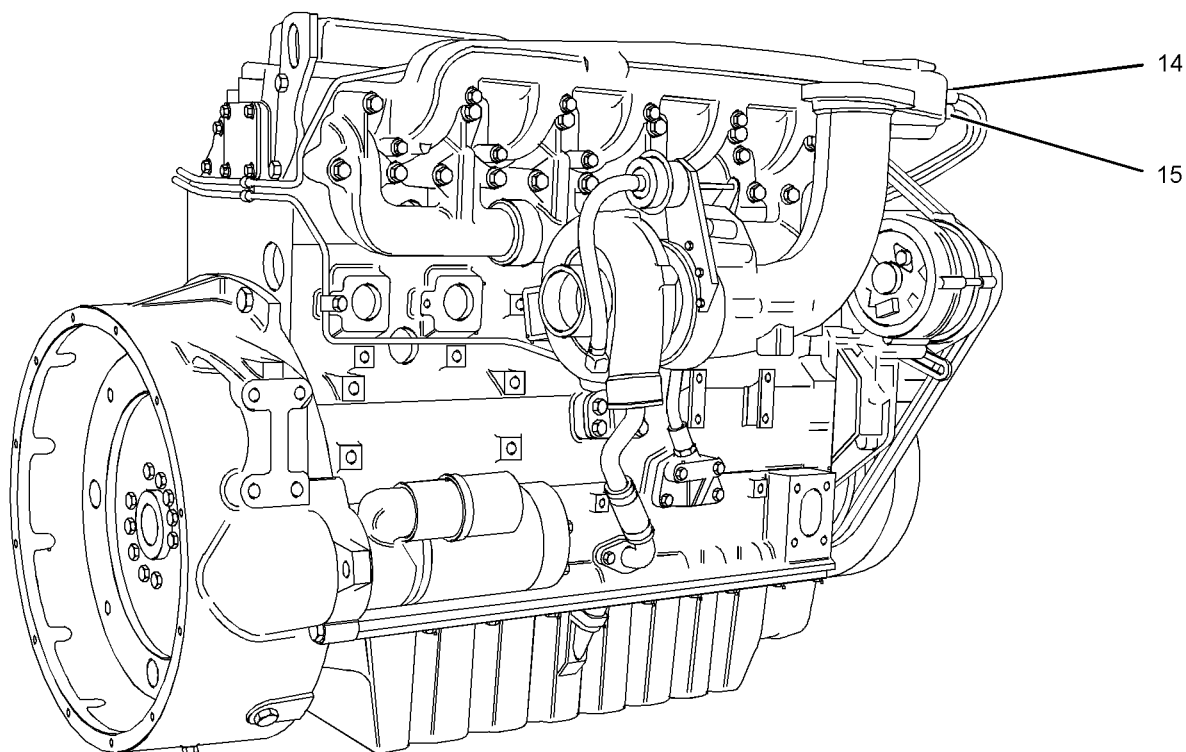


Illustration 11

g01293982

Sensor and connector locations on the right side of the 1106C engine

(14) Intake manifold pressure sensor

(15) Intake manifold air temperature sensor

Table 10

Connector	Function
J1/P1	ECM Connector 70 Pin Machine Harness
J20/P20	Machine Interface Connector (70-Pin Engine Harness)
J40/P40	Fuel Injection Pump (3-Pin Connector)
J100/P100	Engine Coolant Temperature Sensor (2-Pin Connector)
J103/P103	Intake Manifold Air Temperature Sensor (2-Pin Connector)
J200/P200	Intake Manifold Pressure Sensor (3-Pin Connector)
J201/P201	Engine Oil Pressure Sensor (3-Pin Connector)
J401/P401	Speed/Timing Sensor (2-Pin Connector)

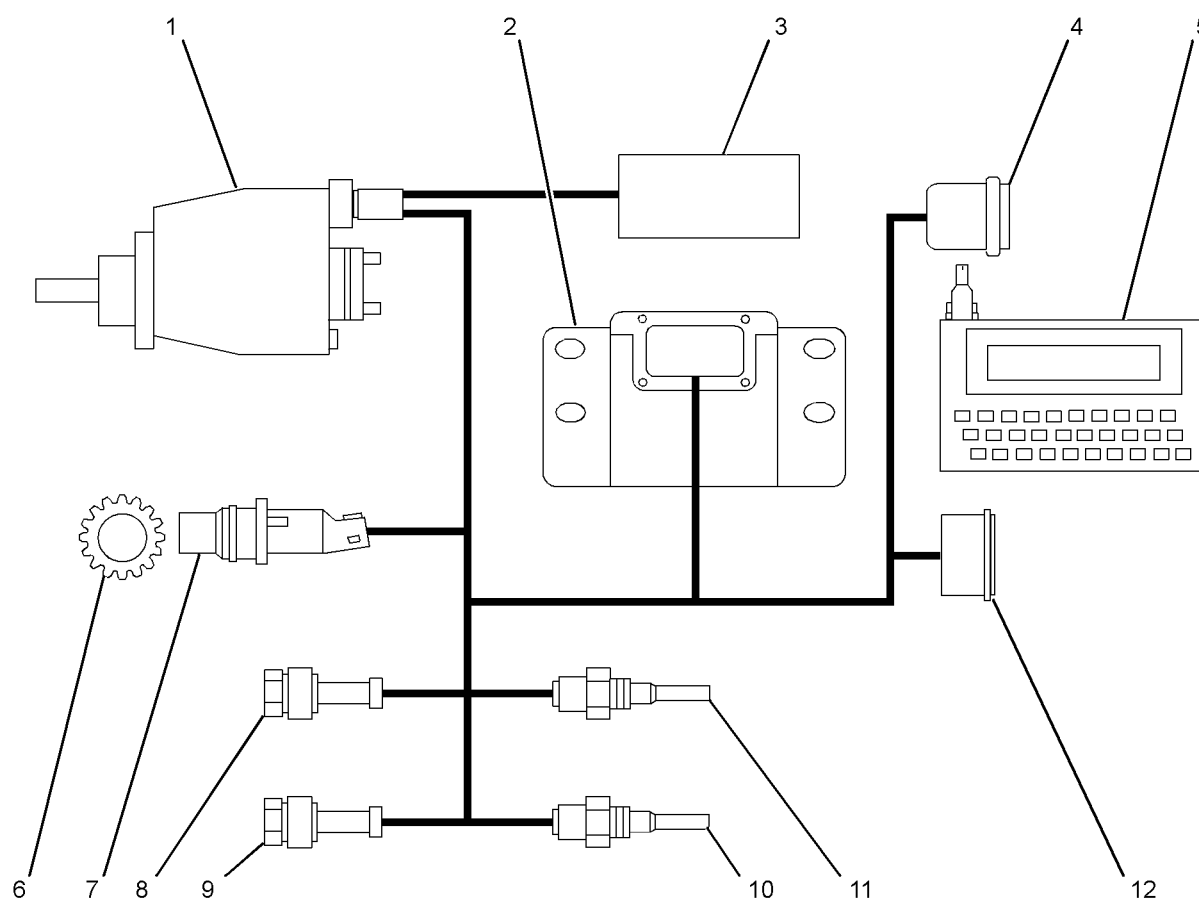


Illustration 12

g01317702

Schematic diagram of the fuel system

- | | | |
|---|-------------------------------------|---|
| (1) Fuel injection pump | (5) Electronic service tool | (9) Engine oil pressure sensor |
| (2) Electronic Control Module (ECM) | (6) 36 -1 tooth crankshaft gear | (10) Intake manifold air temperature sensor |
| (3) Voltage Load Protection Module (VLPM) | (7) Speed/timing sensor | (11) Engine coolant temperature sensor |
| (4) Diagnostic connector | (8) Intake manifold pressure sensor | (12) Machine interface connector |

i04061389

Engine Wiring Information

The wiring diagrams are revised periodically. The wiring diagrams will change with updates to the wiring harness. For the most current information, always check the revision number of the diagram. Use the diagram with the latest revision number.

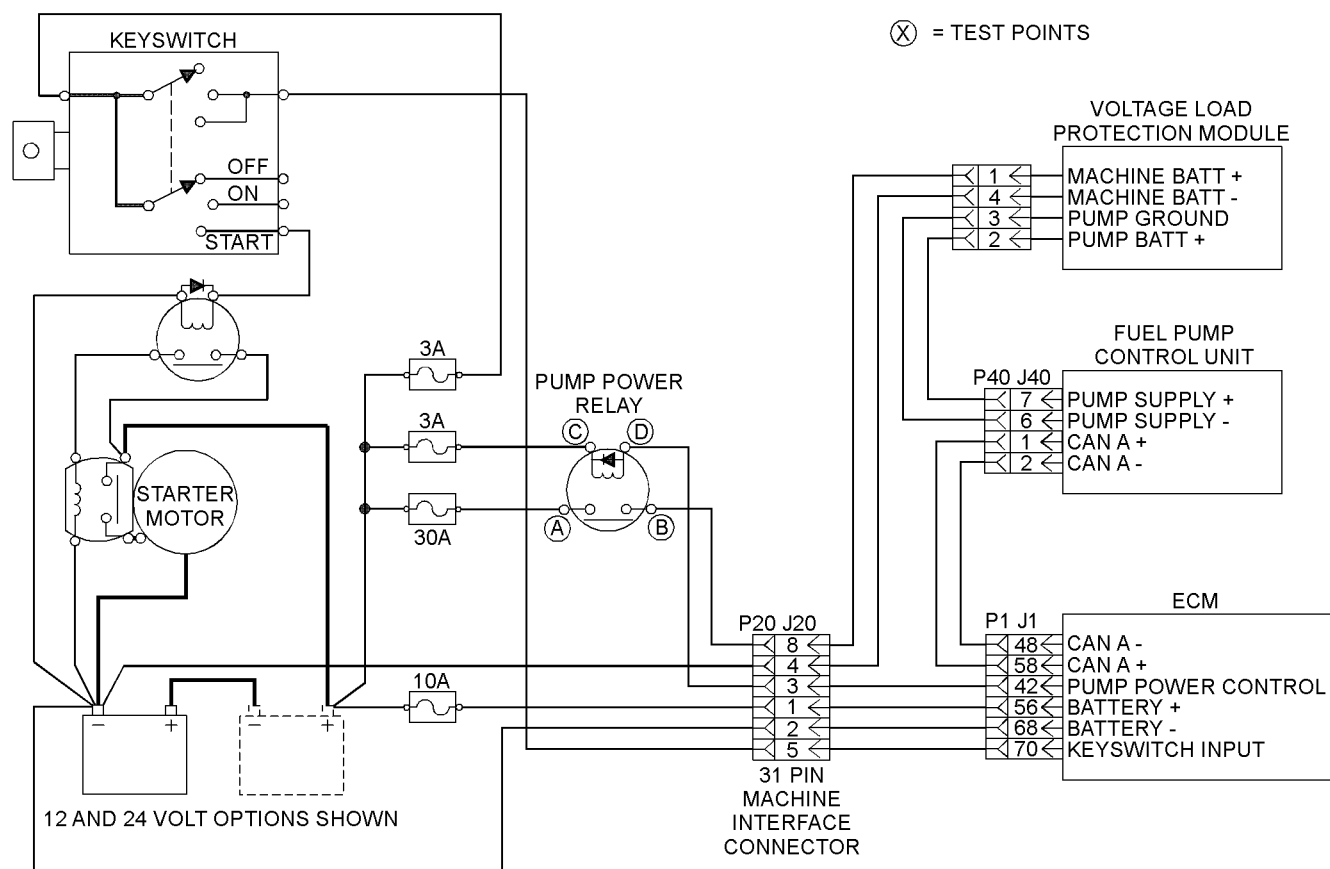


Illustration 13

g01308672

Typical schematic for the fuel injection pump and ECM power supply for engines with a Machine Interface Connector that has 31 pins

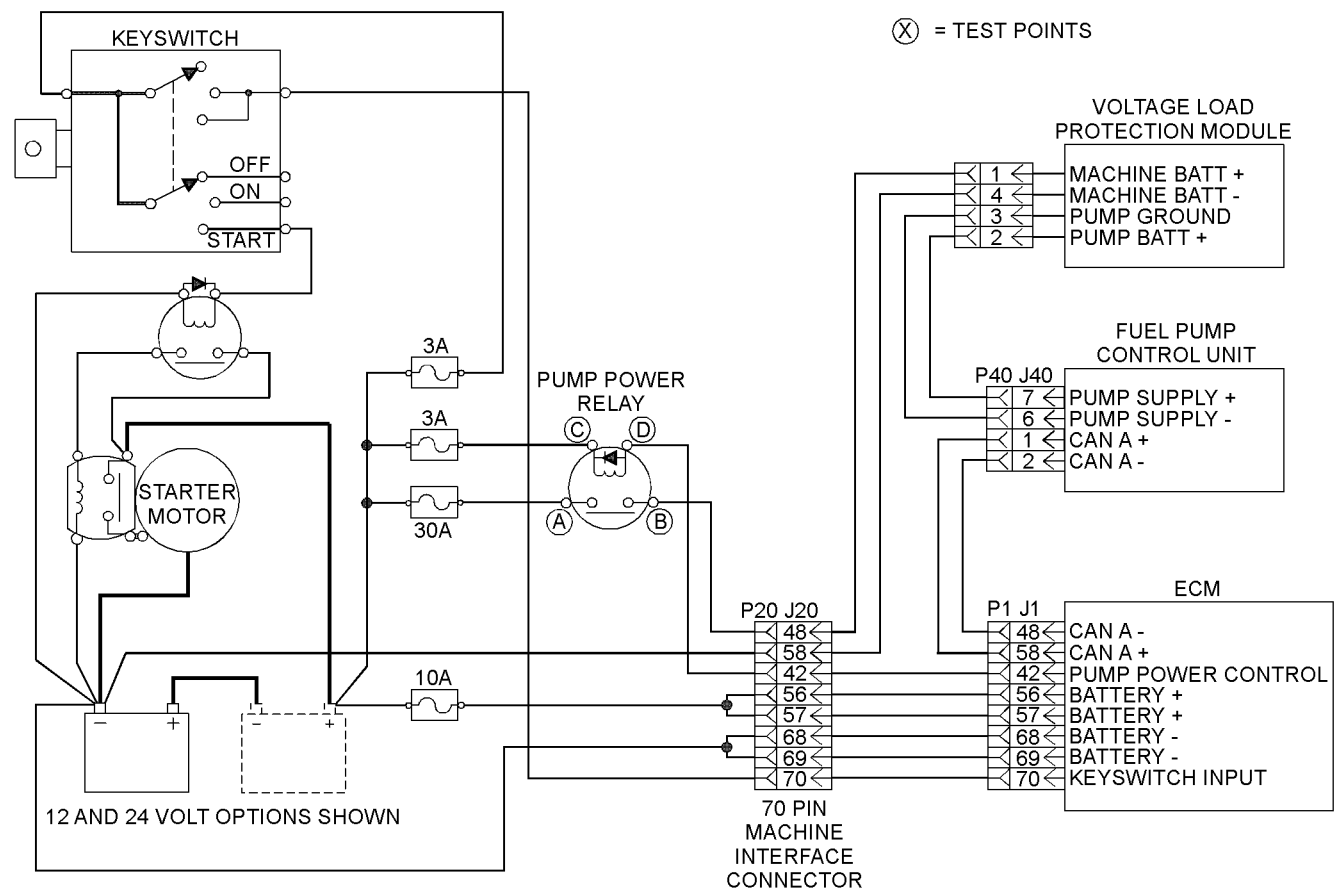


Illustration 14

g01308607

Typical schematic for the fuel injection pump and ECM power supply for engines with a Machine Interface Connector that has 70 pins

Note: Each terminal end of the J1939 CAN data link must be connected with a 120 ohm terminating resistor.

Note: Digital outputs 7,8,9,10,11,12,13, and 14 are only suitable for a 12 V system.

Harness Wire Identification

Perkins identifies all wires with 11 solid colors. The circuit number is stamped on the wire at a 25 mm (1 inch) spacing. Table 11 lists the wire colors and the color codes.

Table 11

Color Codes for the Harness Wire			
Color Code	Color	Color Code	Color
BK	Black	GN	Green
BR	Brown	BU	Blue
RD	Red	PU	Purple
OR	Orange	GY	Gray
YL	Yellow	WH	White
		PK	Pink

For example, a wire identification of F702-GN on the schematic would signify a green wire with the circuit number F702. F702-GN identifies the power supply for the 8 V throttle sensor.

Note: Always replace a harness wire with the same gauge of wire and with the same color code.

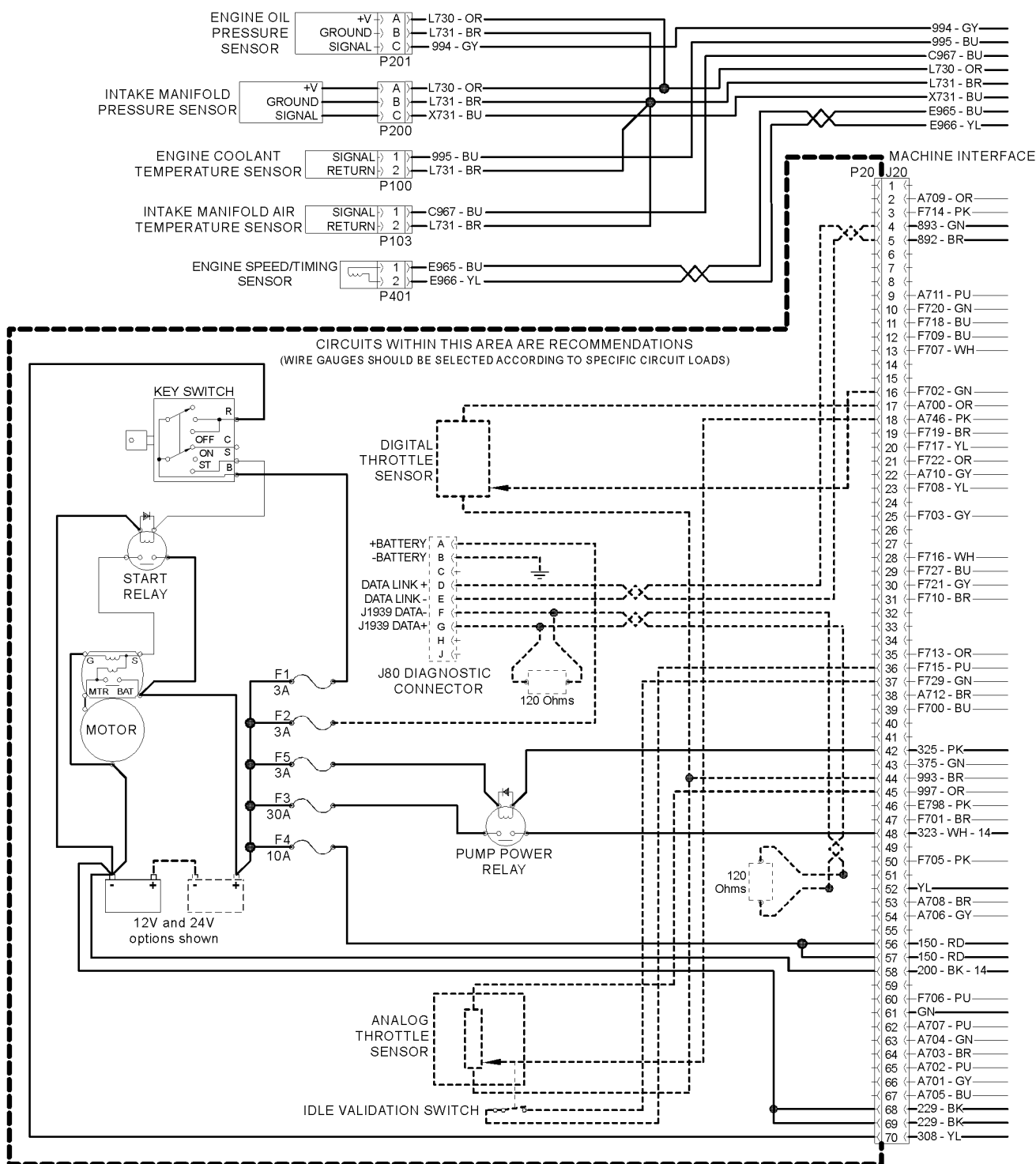
Machine Interface Connector

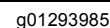
Two types of Machine Interface Connector are available. One type of connector has 31 pins and the other type has 70 pins.

Illustration 13, illustration 17, and illustration 18 show the layout for the Machine Interface Connector with 31 pins.

Illustration 14, illustration 15, and illustration 16 show the layout for the Machine Interface Connector with 70 pins.

Note: Some engines with a Machine Interface Connector that has 70 pins do not have the following wiring connections: 35, 50, 53, 54, 60, 62, 63, 64, and 67.





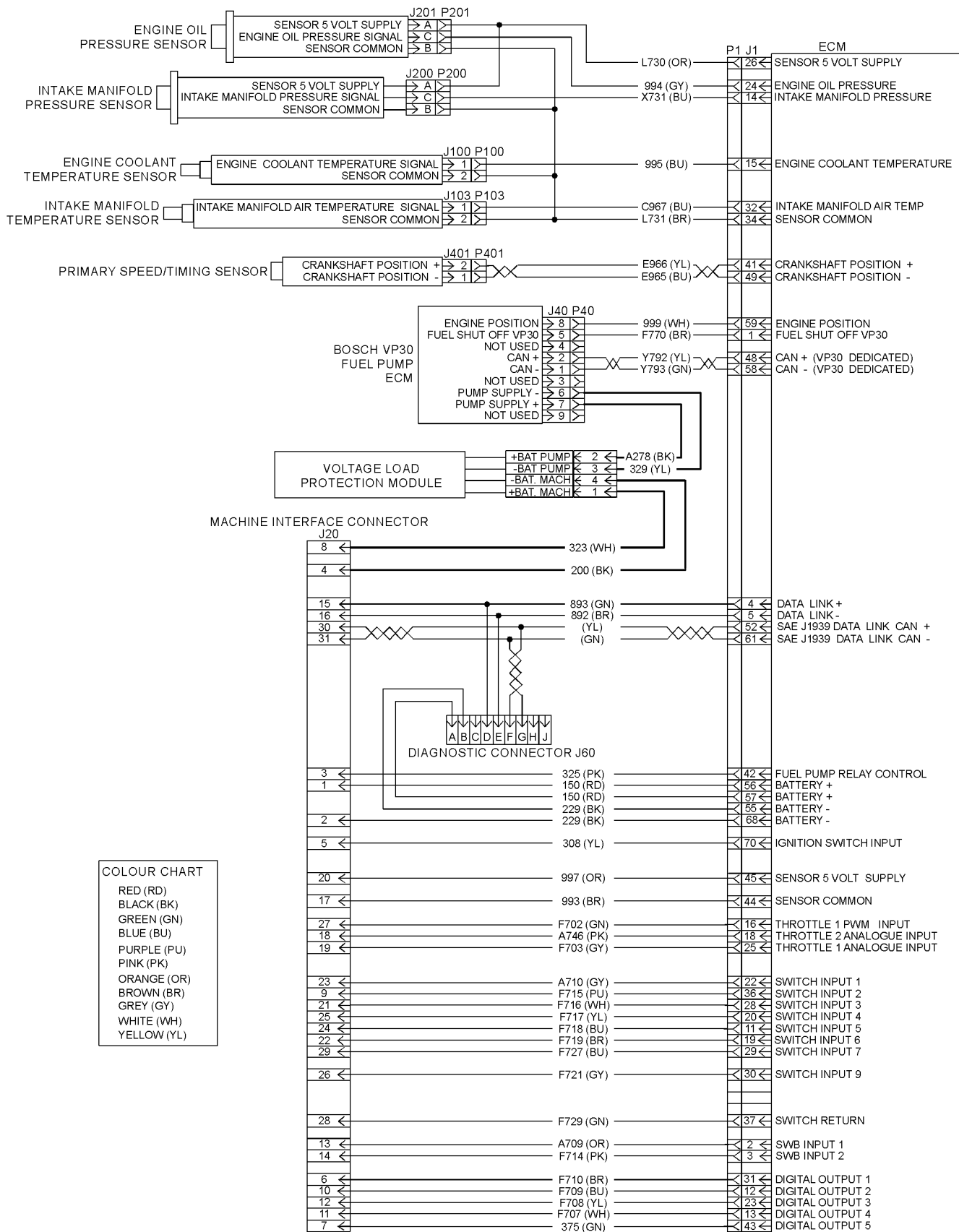
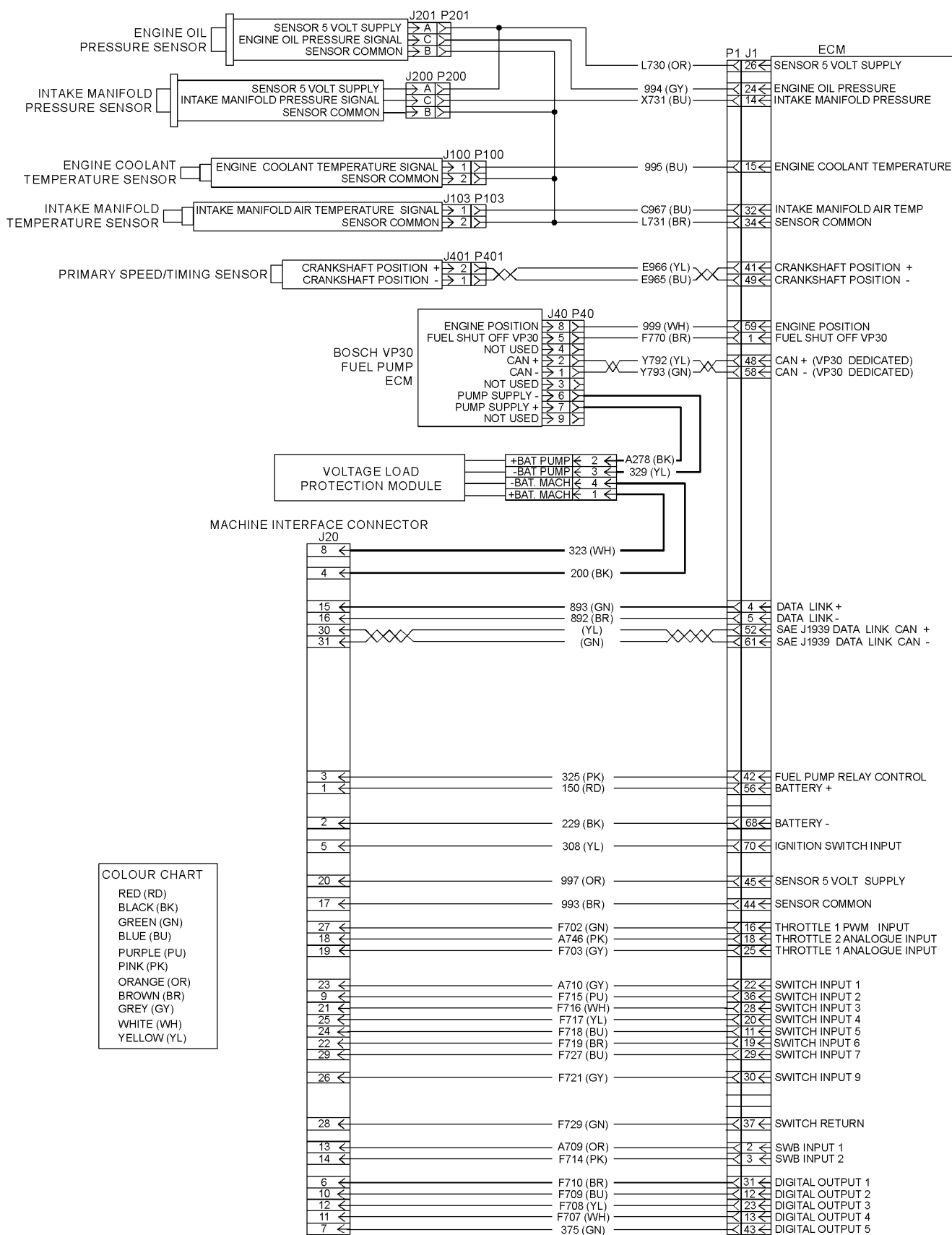


Illustration 17



The procedures in this manual refer to the connector that has 70 pins. Table 12 shows the conversion from engine models that have a connector with 70 pins to engine models that have a connector with 31 pins.

Table 12

Machine Interface Connector Pin Numbers	
70 Pin	31 Pin
2	13
3	14
4	15
5	16
11	24
12	10
13	11
16*	27*
18	18
19	22
20	25
22	23
23	12
25	19
28	21
29	29
30	26
31	6
36	9
37	28
42	3
43	7
44	17
45	20
48	8
52	30
56	1
58	4
61	31
68	2
70	5
* These connections are not used on some engine models.	

Programming Parameters

i01798107

Programming Parameters

The electronic service tool can be used to view certain parameters that can affect the operation of the engine. The electronic service tool can also be used to change certain parameters. The parameters are stored in the Electronic Control Module (ECM). Some of the parameters are protected from unauthorized changes by passwords. Parameters that can be changed have a tattletale number. The tattletale number shows if a parameter has been changed.

i02628797

Factory Passwords

Passwords

Passwords are part of a security system that helps to prevent unauthorized reprogramming of certain parameters. Passwords prevent unauthorized erasing of logged events. Passwords allow the factory to control access to engine calibration parameters. Passwords allow the customer to control access to certain programmable engine parameters.

Factory Passwords

Factory passwords are required to clear any event code. Factory passwords are required to change certain parameters such as Full Load Setting. The factory passwords restrict changes to authorized personnel. When the correct factory passwords have been entered, the changes can then be made.

In order to obtain the proper factory passwords, certain information must be given to an authorized Perkins distributor. Since the factory passwords contain alphabetic characters, the electronic service tool can be used to perform this function. In order to obtain the factory passwords, proceed as if you already have the factory passwords. At some point, if the factory passwords are actually needed, the electronic service tool will request the factory passwords and the electronic service tool will display the information that is required to obtain the factory passwords.

Note: The old interlock code is required to change the interlock code on a used ECM. A new interlock code is also required to change the interlock code on a used ECM.

The electronic service tool screen for factory passwords will display the following parameters:

- Serial number of the Electronic Control Module (ECM)
- Engine serial number
- Serial number for the electronic service tool
- Reason Code
- Total Tattletale number

Note: The factory passwords may only be used for one programming session. A different set of factory passwords will be required after you exit the electronic service tool screen. A different set of passwords will be required to change information on another electronic service tool screen.

i03807230

Flash Programming

Flash Programming – A method of loading a flash file into the Electronic Control Module (ECM)

The electronic service tool can be utilized to program a flash file into the ECM. The programming transfers the flash file from the PC to the ECM.

Flash Programming a Flash File

1. Obtain the part number for the new flash file.

Note: If you do not have the part number for the flash file, use "PTMI" on the Perkins Intranet.

Note: You must have the engine serial number in order to search for the part number for the flash file.

2. Connect the electronic service tool to the service tool connector.
3. Turn the keyswitch to the ON position. Do not start the engine.
4. Select "WinFlash" from the "Utilities" menu on the electronic service tool.

Note: If "WinFlash" will not communicate with the ECM, refer to Troubleshooting, "Electronic Service Tool Will Not Communicate with ECM".

5. Program the flash file into the ECM.

- a. Select the engine ECM under the "Detected ECMs".

- b. Press the "Browse" button in order to select the part number of the flash file that will be programmed into the ECM.
 - c. When the correct flash file is selected, press the "Open" button.
 - d. Verify that the "File Values" match the application. If the "File Values" do not match the application, search for the correct flash file.
 - e. When the correct flash file is selected, press the "Begin Flash" button.
 - f. The electronic service tool will indicate when programming has been successfully completed.
6. Start the engine and check for proper operation.
7. Access the "Configuration" screen under the "Service" menu in order to determine the parameters that require programming. Look under the "Tattletale" column. All of the parameters should have a tattletale of 1 or more. If a parameter has a tattletale of 0, program that parameter.

"WinFlash" Error Messages

If you receive any error messages during programming, click on the "Cancel" button in order to stop the process. Access the information about the "ECM Summary" under the "Information" menu. Ensure that you are programming the correct flash file for your engine.

System Configuration Parameters

i02586801

System Configuration Parameters

System Configuration Parameters affect the emissions of the engine or the power of the engine. System configuration parameters are programmed at the factory. Normally, system configuration parameters would never need to be changed through the life of the engine. System configuration parameters must be reprogrammed if an ECM is replaced. Unless the engine rating has changed, system configuration parameters do not need to be reprogrammed when the flash file is changed. The correct values for these parameters are stamped on the engine information ratings plate. The engine information ratings plate is located on the valve cover or on the air intake manifold. Factory passwords are required to change these parameters. The following information is a description of the system configuration parameters.

“Full Load Setting”

“Full Load Setting” is a number that represents the adjustment to the fuel system that was made at the factory in order to fine tune the fuel system. The correct value for this parameter is stamped on the engine information ratings plate. If the ECM is replaced, the “full load setting” must be reprogrammed in order to prevent a 253-02 diagnostic code from becoming active.

“Full Torque Setting”

“Full Torque Setting” is similar to “Full Load Setting”. If the ECM is replaced, the full torque setting must be reprogrammed in order to prevent a 253-02 diagnostic code from becoming active.

Rating Interlock

The Rating Interlock is a code that prevents the use of an incorrect power rating and/or emission rating for a specific engine. Each horsepower rating and each emission certification has a different code to all other horsepower ratings and emission certifications.

When an ECM is replaced this rating interlock code must match the code that is stored in the ECM. If the rating interlock code does not match the code that is stored in the ECM, both of the following situations will exist:

- The engine will not run.
- Diagnostic code 253-02 will be active.

Note: The flash programming of a new rating interlock replaces the old rating interlock.

This code does not need to be programmed when the replacement ECM is from the same engine rating.

If the ECM is from a different engine rating, then the following components may need to be changed: pistons, fuel injectors, and other components. The engine information ratings plate must also be changed in order to reflect the new rating.

Some systems such as the cooling system or the transmission may also require changes when the engine is rerated. Please contact the local OEM dealer for further information.

“Engine Serial Number”

When a new ECM is delivered, the engine serial number in the ECM is not programmed. The “Engine Serial Number” should be programmed to match the engine serial number that is stamped on the engine information plate.

“ECM Software Release Date”

This parameter is defined by the rating interlock and this parameter is not programmable. The “ECM Software Release Date” is used to provide the version of the software. The Customer parameters and the software change levels can be monitored by this date. The date is provided in the month and the year (NOV04). NOV is the month (November). 04 is the year (2004).

Troubleshooting without a Diagnostic Code

i02586812

Alternator Noise (Noisy Operation)

Note: This is NOT an electronic system problem.

Refer to the Systems Operation, Testing and Adjusting manual for information on determining the cause of this condition.

Probable Causes

- Alternator drive belts
- Alternator drive pulley
- Alternator bearings

Recommended Actions

Alternator Drive Belts

1. Inspect the condition of the alternator drive belts. If the alternator drive belts are worn or damaged, replace the belts. Refer to Disassembly and Assembly, "Alternator - Remove" and Disassembly and Assembly, "Alternator - Install". Ensure that the alternator drive belts are in alignment. Inspect the alternator mounting bracket for cracks and wear. Repair the mounting bracket or replace the mounting bracket in order to ensure that the alternator drive belts and the alternator drive pulley are in alignment.
2. Check the tension on the alternator drive belts. Adjust the tension, if necessary. Refer to Systems Operation, Testing and Adjusting, "V-Belt - Test".

Alternator Drive Pulley

Loosen the nut for the alternator drive pulley and tighten the nut to the correct torque. Refer to Specifications, "Alternator and Regulator" for the correct torque.

Alternator Bearings

Check for excessive play of the shaft in the alternator and check the alternator bearings for excessive wear. The alternator is a nonserviceable item. The alternator must be replaced if the bearings are worn. Refer to Disassembly and Assembly, "Alternator - Remove" and Disassembly and Assembly, "Alternator - Install".

i02586819

Alternator Will Not Charge (Charging Problem)

Note: This is NOT an electronic system fault.

Probable Causes

- Alternator drive belts
- Charging circuit
- Regulator
- Alternator

Recommended Actions

Alternator Drive Belts

1. Inspect the condition of the alternator drive belts. If the alternator drive belts are worn or damaged, replace the belts. Refer to Disassembly and Assembly, "Alternator - Remove" and Disassembly and Assembly, "Alternator - Install".

Check the tension on the alternator drive belts. Adjust the belt tension if the tension is incorrect. Refer to Systems Operation, Testing and Adjusting, "V-Belt - Test".

Charging Circuit

Inspect the battery cables, wiring, and connections in the charging circuit. Clean all connections and tighten all connections. Replace any faulty parts.

Alternator or Regulator

Verify that the alternator or the regulator is operating correctly. Refer to Systems Operation, Testing and Adjusting, "Alternator - Test". The alternator is not a serviceable item. The alternator must be replaced if the alternator is not operating correctly.

i01798112

Battery

Note: This is NOT an electronic system problem.

Probable Causes

- Faulty battery
- Auxiliary device drains the battery current.

Recommended Actions

Faulty Battery

1. Verify that the battery is no longer able to hold a charge. Refer to Testing and Adjusting, "Battery - Test".
2. Replace the battery. Refer to Operation and Maintenance, "Battery - Replace".

Auxiliary Device

1. Verify that the auxiliary device drained the battery by being left in the ON position.
2. Charge the battery.
3. Verify that the battery is able to maintain a charge.

i02588322

Can Not Reach Top Engine RPM

Note: If this problem occurs only under load, refer to Troubleshooting, "Low Power/Poor or No Response to Throttle".

Probable Causes

- Diagnostic codes
- ECM parameters
- Throttle position sensor
- Air intake and exhaust system
- Fuel supply
- Individual malfunctioning cylinders
- Fuel injection nozzles

Recommended Actions

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

ECM Parameters

1. Ensure that the problem is not a programmed parameter.
2. Ensure that the correct mode was selected by using the electronic service tool.
3. Use the electronic service tool to verify the correct engine rating for the engine.
4. Use the electronic service tool to verify the maximum engine speed limit.
5. Use the electronic service tool to reset the parameters to the OEM specifications.
6. Ensure that the repairs have eliminated the performance problems.
7. If the repairs have not eliminated the faults proceed to "Throttle Position Sensor".

Throttle Position Sensor

1. Use the electronic service tool and observe the signal for the throttle position sensor.
2. If the signal is erratic, refer to Troubleshooting, "Throttle Position Sensor Circuit - Test".
3. If the engine has a throttle switch refer to Troubleshooting, "Throttle Switch Circuit - Test".
4. If the repairs have not eliminated the faults proceed to "Air Intake and Exhaust System".

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.
2. Ensure that the air filter is clean and serviceable.
3. Check the air intake and the exhaust system for the following defects:
 - Blockages
 - Restrictions
 - Damage to the air intake and exhaust lines and hoses
4. Make all necessary repairs to the engine.

5. Ensure that the repairs have eliminated the diagnostic code.
6. If the problem has not been eliminated, proceed to "Fuel Supply".

Fuel Supply

1. Check the fuel pressure. Refer to Systems Operation, Testing and Adjusting, "Fuel System Pressure - Test".
2. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
3. Check the diesel fuel for contamination. Refer to Systems Operation, Testing and Adjusting, "Fuel Quality - Test".
4. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".
5. Check that the fuel lines are tight and secured properly.
6. Check for fuel supply lines that are restricted.
7. Check the fuel filters.
8. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
9. If the engine has a water separator, check for water in the fuel.
10. Ensure that the fuel supply valve is in the full OPEN position.
11. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).
12. If the repairs do not eliminate the problem proceed to "Individual Malfunctioning Cylinders".

Individual Malfunctioning Cylinders

1. With the engine speed at a fast idle, loosen the high pressure fuel line to the fuel injection nozzle of number 1 cylinder. Note if there is any reduction in engine speed. Tighten the high pressure fuel line to the fuel injection nozzle.
2. If all cylinders have been checked and no problems were detected proceed to "Fuel Injection Nozzles".

Fuel Injection Nozzles

1. Remove the fuel injection nozzles from the cylinder head. Refer to Disassembly and Assembly, "Fuel Injection Nozzle - Remove".
2. Check the fuel injection nozzles. Refer to Testing and Adjusting, "Fuel Injection Nozzle - Test".
3. Ensure that the repairs have eliminated the problems.

i02591040

Coolant in Engine Oil

Note: This is not an electronic system problem.

Refer to Testing and Adjusting for information on determining the cause of this condition.

Probable Causes

- Engine oil cooler core
- Cylinder head gasket
- Cylinder head
- Cylinder block

Recommended Actions

Engine Oil Cooler Core

1. Drain the engine lubricating oil from the engine.
2. Check for leaks in the oil cooler core. Refer to Systems Operation, Testing and Adjusting, "Cooling System" for the correct procedure. If a leak is found, install a new oil cooler core. Refer to Disassembly and Assembly, "Engine Oil Cooler - Remove" and Disassembly and Assembly, "Engine Oil Cooler - Install" for the correct procedures. Fit new seals between the oil cooler and the oil cooler cover.

Cylinder Head Gasket

1. Remove the cylinder head. Refer to Disassembly and Assembly, "Cylinder Head - Remove" for the correct procedure.
2. Inspect the cylinder head gasket for faults and any signs of leakage.

Cylinder Head

1. Check the cylinder head for flatness. Refer to Systems Operation, Testing and Adjusting, "Cylinder Head - Inspect" for the correct procedure.
2. Check for cracks in the cylinder head. If a crack is found, repair the cylinder head and/or replace the cylinder head.
3. If the cylinder head is flat and if the cylinder head is not cracked then refer to the recommended actions for the Cylinder Block.

Cylinder Block

1. Inspect the cylinder block for cracks. Refer to Systems Operation, Testing and Adjusting, "Cylinder Block - Inspect". If a crack is found, repair the cylinder block or replace the cylinder block.
2. Check the cylinder liner projection. Refer to Systems Operation, Testing and Adjusting, "Cylinder Liner Projection - Inspect" for more information. Correct the cylinder liner projection if it is incorrect.
3. If any of the cylinder liner projections were incorrect and this had resulted in the failure of the head gasket, install a new head gasket. Install the cylinder head. Refer to Disassembly and Assembly, "Cylinder Head - Install" for the correct procedure.

i02591053

Coolant Temperature Is Too High

Note: This is not an electronic system problem.

Refer to Systems Operation, Testing and Adjusting for information on determining the cause of this condition.

Probable Causes

- Radiator fins
- Coolant level
- Radiator cap and/or pressure relief valve
- Coolant temperature gauge
- Restriction in the coolant system
- Water temperature regulator

- Engine cooling fan
- Coolant pump
- Cylinder head gasket
- Excessive load on the system

Recommended Actions

Radiator Fins

Check the radiator fins for dirt, debris, and/or damage. Remove any dirt and/or debris and straighten any bent fins.

Coolant Level

1. Inspect the coolant level. If necessary, add coolant.
2. Check the cooling system for leaks. Repair any leaks immediately.

Radiator Cap and/or Pressure Relief Valve

1. Pressure test the cooling system. Refer to Systems Operation, Testing and Adjusting, "Cooling System" for the correct procedure.
2. Check operation of the pressure relief valve and the radiator cap. If necessary, clean the components and/or replace the components.
3. Check that the seating surfaces of the pressure relief valve and the radiator cap are clean and undamaged.

Coolant Temperature Gauge

Compare the reading for the coolant temperature from the electronic service tool to the reading for the coolant temperature from a mechanical gauge.

Restriction in the Coolant System

1. Visually inspect the cooling system for collapsed hoses and/or other restrictions.
2. Clean the radiator and flush the radiator. Refer to Systems Operation, Testing and Adjusting, "Cooling System".

Water Temperature Regulator

i02270218

Check the water temperature regulator for correct operation. Refer to Systems Operation, Testing and Adjusting, "Cooling System" for the proper procedure. If necessary, replace the water temperature regulator. Refer to Disassembly and Assembly, "Water Temperature Regulator - Remove and Install" for more information.

Engine Cooling Fan

1. Make sure that the engine cooling fan is correctly installed.
2. Make sure that the engine cooling fan is being driven correctly by the drive belt. If necessary, tighten the drive belt or replace the drive belt. Refer to Disassembly and Assembly, "Alternator Belt - Remove and Install".
3. Check the engine cooling fan for damage. If necessary, replace the fan. Refer to Disassembly and Assembly, "Fan - Remove and Install".

Coolant Pump

Inspect the impeller of the coolant pump for damage and/or erosion. If necessary, repair the coolant pump or replace the coolant pump.

Cylinder Head Gasket

Switch off the engine and allow the engine to cool to below normal working temperature. Remove the pressure cap for the coolant system. Start the engine and inspect the coolant for the presence of bubbles. If bubbles are present in the coolant, combustion gases may be entering the cooling system. Check the cylinder head gasket. Refer to the recommended action for the cylinder head gasket within Troubleshooting, "Coolant in Engine Oil". Check the cylinder head for flatness. Refer to the recommended action for checking flatness of the cylinder head within Systems Operation, Testing and Adjusting, "Cylinder Head - Inspect". Fit the pressure cap if there are no bubbles in the coolant.

Excessive Load on the System

Reduce the load and verify that the condition does not reoccur.

ECM Will Not Accept Factory Passwords

WARNING

The connection of any electrical equipment and the disconnection of any electrical equipment may cause an explosion hazard which may result in injury or death. Do not connect any electrical equipment or disconnect any electrical equipment in an explosive atmosphere.

Probable Causes

One of the following items may not be recorded correctly on the electronic service tool:

- Passwords
- Serial numbers
- Total tattletale
- Reason code

Recommended Actions

1. Verify that the correct passwords were entered. Check every character in each password. Remove the electrical power from the engine for 30 seconds and then retry.
2. Verify that the electronic service tool is on the "Factory Password" screen.
3. Use the electronic service tool to verify that the following information has been entered correctly:
 - Engine serial number
 - Serial number for the electronic control module
 - Serial number for the electronic service tool
 - Total tattletale
 - Reason code

i01798117

ECM Will Not Communicate with Other Systems or Display Modules

Probable Causes

- ECM
- Electrical connectors
- Data Link

Recommended Actions

1. Connect the electronic service tool to the service tool connector. If the ECM does not communicate with the electronic service tool, refer to Troubleshooting, "Electronic Service Tool Will Not Communicate with ECM".
2. Ensure that the following items are correctly installed and undamaged. Refer to Troubleshooting, "Electrical Connectors - Inspect".
 - J1/P1 ECM connector
 - J20/P20 Machine interface connector
 - Wiring to display modules
 - Wiring to other control modules
3. Troubleshoot the Data Link for possible problems. Refer to Troubleshooting, "Data Link Circuit - Test".

i02591091

Electronic Service Tool Will Not Communicate with ECM

Probable Causes

- Configuration for the communications adapter
- Electrical connectors
- Communication adapter and/or cables
- Electrical power supply to the service tool connector
- Electronic service tool and related hardware

- Electrical power supply to the Electronic Control Module (ECM)
- Data Link

Recommended Actions

Start the engine. If the engine starts, but the ECM will not communicate with the electronic service tool, continue with this procedure. If the engine will not start, refer to Troubleshooting, "Engine Cranks but Will Not Start". If the engine will not crank, refer to Troubleshooting, "Engine Will Not Crank".

Configuration for the Communications Adapter

1. Access "Preferences" under the "Utilities" menu on the electronic service tool.
2. Verify that the correct "Communications Interface Device" is selected.
3. Verify that the correct port is selected for use by the communication adapter.

Note: The most commonly used port is "COM 1".

4. Check for any hardware that is utilizing the same port as the communications adapter. If any devices are configured to use the same port, exit or close the software programs for that device.

Electrical Connectors

Check for correct installation of the P1/J1 ECM connector and of the diagnostic connector. Refer to Troubleshooting, "Electrical Connectors - Inspect".

Communication Adapter and/or Cables

1. Make sure that the firmware and driver files are the most current files that are available for the type of communication adapter that is being used. If the firmware and driver files do not match, the communication adapter will not communicate with the electronic service tool.
2. Disconnect the communication adapter and the cables from the service tool connector. Reconnect the communication adapter to the service tool connector.
3. Verify that the correct cable is being used between the communication adapter and the diagnostic connector. Refer to Troubleshooting, "Electronic Service Tools".

4. If the laptop computer is using a Windows operating system, restart the laptop computer in order to eliminate the possibility of a conflict in the software.

Electrical Power Supply to the Service Tool Connector

Verify that battery voltage is present between terminals A and B of the diagnostic connector. If the communication adapter is not receiving power, the LED display on the communication adapter will be blank.

Electronic Service Tool and Related Hardware

In order to eliminate the electronic service tool and the related hardware as the problem, connect the electronic service tool to a different engine. If the same problem occurs on a different engine, check the electronic service tool and the related hardware in order to determine the cause of the fault.

Electrical Power Supply to the Electronic Control Module (ECM)

Check power to the ECM. Refer to Systems Operation, Testing and Adjusting, "Charging System - Test".

Note: If the ECM is not receiving battery voltage, the ECM will not communicate.

Data Link

Troubleshoot the data link for possible faults. Refer to Troubleshooting, "Data Link Circuit - Test".

i02591106

Engine Cranks but Will Not Start

Probable Causes

- Diagnostic codes
- Air intake and exhaust system
- Air inlet heater starting aid (if equipped)
- Glow plugs (if equipped)
- Valve lash
- Fuel supply

- Low compression (cylinder pressure)
- Fuel injectors

Recommended Actions

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

Visual Checks

1. Visually inspect the engine for the following faults:
 - Missing components
 - Damaged components
 - Oil leaks
 - Coolant leaks
 - Fuel leaks
 - Hydraulic leaks
 - Check electrical cables for damage. Check that the electrical cables are properly secured.
 - Check for the proper level of fuel, oil, coolant, and hydraulic fluids
2. Try to start the engine. If the engine does not start, verify that the crankshaft is rotating. Use a suitable hand tool in order to rotate the crankshaft.
3. If the crankshaft does not rotate freely, check the engine for the following problems:
 - Seized piston
 - Defects in the drive gears
 - Fluid in the cylinder bores
 - Improper timing of valves

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.
2. Ensure that the air filter is clean and serviceable.
3. Check the air intake and exhaust systems for the following defects:
 - Blockages
 - Restrictions

- Damage to lines or hoses
- 4. Repair any defects before attempting to restart the engine.
- 5. If the engine will not start proceed to "Air Inlet Heater Starting Aid".

Air Inlet Heater Starting Aid (if equipped)

1. Check for proper operation of the air inlet heater starting aid. Refer to Systems Operation, Testing and Adjusting, "Air Inlet Heater - Test".
2. If the repairs do not eliminate the fault refer to "Glow Plugs".

Glow Plugs (if equipped)

Note: Faulty glow plugs will only affect engine starting when the ambient temperature is below 10 °C (50 °F).

1. Check the operation of the glow plugs. Refer to Systems Operation, Testing and Adjusting, "Glow Plugs - Test".
2. If necessary, replace faulty glow plugs. Refer to Disassembly and Assembly, "Glow Plug - Remove and Install".
3. If the repairs do not eliminate the fault, proceed to "Valve Lash".

Valve Lash

1. Check the valve lash and reset the valve lash if it is necessary. Refer to Systems Operation, Testing and Adjusting, "Engine Valve Lash - Inspect and Adjust".

Ensure that the repairs have eliminated the active diagnostic codes before attempting to restart the engine.

If the engine will not start proceed to "Fuel Supply".

Fuel Supply

1. Check the fuel pressure. Refer to Systems Operation, Testing and Adjusting, "Fuel System Pressure - Test".
2. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
3. Check the diesel fuel for contamination. Refer to Systems Operation, Testing and Adjusting, "Fuel Quality - Test".

4. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".
5. Check that the fuel lines are tight and secured properly.
6. Check for fuel supply lines that are restricted.
7. Check the fuel filters.
8. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
9. If the engine has a water separator, check for water in the fuel.
10. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
11. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).
12. Check the fuel injection pump. Refer to Troubleshooting, "Fuel Injection Pump Circuit - Test".

If the engine will not start proceed to "Low Compression".

Low Compression (cylinder pressure)

1. Remove the fuel injectors and perform a compression test. Refer to Systems Operations, Testing and Adjusting, "Compression - Test" data.

Examples of low compression are shown in the following list:

- Outside temperatures are too cold.
- Mechanical problem
- Faulty piston rings
- Worn cylinder bores
- Worn valves
- Faulty cylinder head gasket
- Damaged cylinder head

2. Make all necessary repairs to the engine.
3. Ensure that the repairs have eliminated the active diagnostic code.
4. If the engine will not start proceed to "Fuel Injectors".

Fuel Injectors

1. Remove the fuel injectors from the cylinder head. Refer to Disassembly and Assembly, "Fuel Injectors - Remove".
2. Visually inspect the fuel injectors. If a fuel injector has a suspected fault, replace the fuel injector. Refer to Disassembly and Assembly, "Fuel Injector - Remove" and Disassembly and Assembly, "Fuel Injector - Install".

i02591271

Engine Has Early Wear

Note: This is not an electronic system problem.

Probable Causes

- Multiple starts or cold operation
- Incorrect maintenance intervals
- Dirt in engine oil
- Incorrect oil
- Contaminated oil
- Leaks in air intake system
- Dirt in fuel
- Low oil pressure

Recommended Actions

Multiple Starts or Cold Operation

Frequent starting and stopping of the engine can cause early wear. Also, operation of the engine for short periods of time in cold conditions can cause early wear.

Incorrect Maintenance Intervals

If the engine is not correctly maintained, early wear will occur.

Make sure that the engine is maintained at the correct maintenance intervals. Refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule".

Dirt in Engine Oil

1. Drain the oil from the crankcase and refill the crankcase with clean engine oil. Install new engine oil filters. Refer to the Operation and Maintenance Manual for more information.

Incorrect Oil

1. Check that the engine is filled with oil of the correct specification. Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations".
2. If necessary, drain the engine oil system and refill the engine oil system. Change the oil filter. Refer to Operation and Maintenance Manual, "Engine Oil and Filter - Change".

Contaminated Oil

Check an oil sample for contamination with fuel. If contamination is found, investigate the cause.

Leaks in Air Intake System

A leak in the air intake system may allow unfiltered air into the engine. Inspect the air intake system for streaks which may indicate a leakage of unfiltered air. Inspect all of the gaskets and the connections. Repair any leaks. Refer to Systems Operation, Testing and Adjusting, "Air Inlet and Exhaust System - Inspect" for more information.

Dirt in Fuel

1. Remove the fuel filters. Inspect the fuel filters for contamination. Install new fuel filters. Refer to the Operation and Maintenance Manual, "Fuel System Primary Filter (Water Separator) Element - Replace" and Operation and Maintenance Manual, "Fuel System Secondary Filter - Replace". Determine the cause of the contamination.
2. Check the diesel fuel for contamination. Refer to Systems Operation, Testing and Adjusting, "Fuel Quality - Test".

Low Oil Pressure

Refer to Troubleshooting, "Low Engine Oil Pressure" for the testing procedure. Repair any identified faults.

i02593724

Engine Misfires, Runs Rough or Is Unstable

The probable root causes are listed in order below:

Note: If the fault is intermittent and the problem cannot be duplicated, refer to Troubleshooting, “Intermittent Low Power or Power Cutout”.

Note: If the fault only occurs under certain conditions, test the engine under those conditions. Examples of certain conditions are high rpm, full load and engine operating temperature. Troubleshooting the symptoms under other conditions can give misleading results.

Probable Causes

- Diagnostic codes
- Throttle position sensor
- Air intake and exhaust system
- Air inlet heater starting aid (if equipped)
- Glow plugs (if equipped)
- Fuel supply
- Low compression (cylinder pressure)
- Individual malfunctioning cylinder
- Fuel injection pump
- Fuel injectors

Recommended Actions

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

Throttle Position Sensor

1. Use the electronic service tool and observe the signal for the throttle position sensor. Make sure that the throttle reaches the 100% raw position and the calibrated position.
2. If the signal is erratic, refer to Troubleshooting, “Analog Throttle Position Sensor Circuit - Test” or Troubleshooting, “Digital Throttle Position Sensor Circuit - Test”.
3. If the engine has a 10 position throttle switch refer to Troubleshooting, “Throttle Switch Circuit - Test”.
4. If the repairs do not eliminate the fault proceed to “Air Intake and Exhaust System”.

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.
2. Ensure that the air filter is clean and serviceable.
3. Check the air intake and exhaust systems for the following defects:
 - Blockages
 - Restrictions
 - Damage to lines or hoses
4. If the repairs do not eliminate the fault proceed to “Air Inlet Heater Starting Aid”.

Air Inlet Heater Starting Aid (if equipped)

1. Check for proper operation of the air inlet heater starting aid. Refer to Systems Operation, Testing and Adjusting, “Air Inlet Heater - Test”.
2. If the repairs do not eliminate the fault refer to “Glow Plugs”.

Glow Plugs (if equipped)

Note: Faulty glow plugs will only affect engine starting when the ambient temperature is below 10 °C (50 °F).

1. Check the operation of the glow plugs. Refer to Systems Operation, Testing and Adjusting, “Glow Plugs - Test”.
2. If necessary, replace faulty glow plugs. Refer to Disassembly and Assembly, “Glow Plug - Remove and Install”.
3. If the repairs do not eliminate the fault, proceed to “Fuel Supply”.

Fuel Supply

1. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
2. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
3. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).
4. Check the primary filter/water separator for water in the fuel.
5. Check for fuel supply lines that are restricted.
6. Check that the low pressure fuel lines are tight and secured properly.

7. Check the fuel filters.
8. Check the diesel fuel for contamination. Refer to Systems Operation, Testing and Adjusting, "Fuel Quality - Test".
9. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".
10. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
11. Check the fuel pressure. Refer to Systems Operation, Testing and Adjusting, "Fuel System Pressure - Test".
12. If the repair does not eliminate the fault refer to "Low Compression (Cylinder Pressure)".

Low Compression (Cylinder Pressure)

1. Perform a compression test. Refer to Systems Operation, Testing and Adjusting, "Compression - Test".
2. If low compression is noted on any cylinders, investigate the cause and rectify the cause.

Possible causes of low compression are shown in the following list:

- Loose glow plugs (if equipped)
- Faulty piston
- Faulty piston rings
- Worn cylinder bores
- Worn valves
- Faulty cylinder head gasket
- Damaged cylinder head

3. Perform all necessary repairs.
4. Ensure that the repairs have eliminated the faults.
5. If the repair does not eliminate the fault refer to "Individual Malfunctioning Cylinders".

Individual Malfunctioning Cylinders

1. With the engine speed at a fast idle, loosen the high pressure fuel line to the fuel injector of number 1 cylinder. Note if there is any reduction in engine speed. Tighten the high pressure fuel line to the fuel injector.

2. Individually repeat this procedure for each fuel injector. If there is no reduction in the engine speed, investigate the cause of the malfunction.
3. If the repair does not eliminate the fault refer to "Fuel Injection Pump".

Fuel Injection Pump

Note: The fuel injection pumps that are installed by the factory on the 1100 series engines are nonserviceable items. If any mechanical fault or any electrical fault occurs within the fuel injection pump then the fuel injection pump must be replaced.

1. Use the electronic service tool to select the correct screen display. Refer to Troubleshooting, "Troubleshooting with a Diagnostic Code".
2. If the repair does not eliminate the fault refer to "Fuel Injectors".

Fuel Injectors

1. Remove the fuel injectors from the cylinder head. Refer to Disassembly and Assembly, "Fuel Injector - Remove".
2. Visually inspect the fuel injectors. If a fuel injector has a suspected fault, replace the fuel injector.
3. Install the fuel injectors into the cylinder head. Refer to Disassembly and Assembly, "Fuel Injector - Install".

i02594246

Engine Oil in Cooling System

Note: This is not an electronic system problem.

Refer to Systems Operation, Testing and Adjusting for information on determining the cause of this condition.

Probable Causes

- Engine oil cooler core
- Cylinder head gasket
- Cylinder head
- Cylinder Block

Recommended Actions

Engine Oil Cooler Core

1. Drain the coolant from the engine and the radiator. Drain the lubricating engine oil from the engine oil cooler. Refer to the Operation and Maintenance Manual for more information.
2. Inspect the engine oil cooler core for leaks. Refer to Systems Operation, Testing and Adjusting, "Cooling System" for the correct procedure. If a leak is found, replace the oil cooler core. Refer to Disassembly and Assembly, "Engine Oil Cooler Core - Remove". Fit new seals between the oil cooler and the oil cooler cover.
3. Refill the crankcase with clean engine oil to the correct level. Refer to the Operation and Maintenance Manual for more information.

Cylinder Head Gasket

1. Remove the cylinder head. Refer to Disassembly and Assembly, "Cylinder Head - Remove" for the correct procedure.
2. Inspect the cylinder head gasket for faults and any signs of leakage.
3. If the engine is equipped with cylinder liners, check the cylinder liner projection. Refer to Systems Operation, Testing and Adjusting, "Cylinder Liner Projection - Inspect" for the correct procedure.
4. If any of the cylinder liner projections were incorrect, and this had resulted in the failure of the head gasket, fit a new head gasket. Refer to Disassembly and Assembly, "Cylinder Head - Install" for the correct procedure.
5. Check the cylinder head for flatness. Refer to Systems Operation, Testing and Adjusting, "Cylinder Head - Inspect" for the correct procedure.
6. Check the cylinder head for cracks. If a crack is found, repair the cylinder head and/or replace the cylinder head.

Cylinder Block

Inspect the top face of the cylinder block for faults and signs of leakage. If a fault is found, replace the cylinder block. If signs of leakage are found, determine the cause of the leakage. Refer to Systems Operation, Testing and Adjusting, "Cylinder Block - Inspect" for the correct procedure.

Assembly after Repair

1. Install the cylinder head. Refer to Disassembly and Assembly, "Cylinder Head - Install".

2. Replenish the engine with clean engine oil to the correct level. Refer to the Operation and Maintenance Manual, "Engine Oil and Filter - Change" for more information.
3. Thoroughly flush the coolant system in order to remove all traces of the engine lubricating oil from the coolant system. Fill the coolant system with coolant. Refer to the Operation and Maintenance Manual, "Cooling System Coolant (ELC) - Change".

i02594276

Engine Stalls at Low RPM

Probable Causes

- Diagnostic codes
- Accessory equipment
- Remote torque speed control (if equipped)
- Fuel supply
- Fuel injectors

Recommended Actions

Diagnostic Codes

Use the electronic service tool to check for active diagnostic codes. Troubleshoot any active codes before continuing with this procedure.

Accessory Equipment

Check all accessory equipment for faults that may create excessive load on the engine. Repair any damaged components or replace any damaged components.

Remote Torque Speed Control (If Equipped)

1. Check the Data Link. Refer to Troubleshooting, "Data Link Circuit - Test".
2. Check the engine wiring harness for defects. Refer to Troubleshooting, "Electrical Connectors - Inspect".

Fuel Supply

1. Check the fuel pressure. Refer to Systems Operation, Testing and Adjusting, "Fuel System Pressure - Test".

2. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
3. Check the diesel fuel for contamination. Refer to Systems Operation, Testing and Adjusting, "Fuel Quality - Test".
4. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".
5. Check that the fuel lines are tight and secured properly.
6. Check for fuel supply lines that are restricted.
7. Check the fuel filters.
8. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
9. If the engine has a water separator, check for water in the fuel.
10. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
11. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).

NOTICE

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

Fuel Injectors

1. Check for correct installation of the fuel injectors. Refer to Disassembly and Assembly, "Fuel Injector - Install".
2. If a fault is suspected in the fuel injectors, replace the fuel injectors. Refer to Disassembly and Assembly, "Fuel Injector - Remove" and Disassembly and Assembly, "Fuel Injector - Install".

i02594360

Engine Vibration

Note: This is not an electronic system fault.

Refer to Systems Operation, Testing and Adjusting for information on determining the cause of this condition.

Probable Causes

- Engine supports
- Low compression (cylinder pressure)
- Fuel injectors
- Malfunctioning individual cylinder

Recommended Actions

Engine Supports

1. Start the engine and run the engine through the speed range. Check for any of the following conditions:
 - Loose engine supports
 - Loose mounting brackets or broken mounting brackets
 - Loose bolts
 - Omitted bolts
2. Make all necessary repairs. Ensure that the repairs have eliminated the fault. If the vibration is still present, proceed to "Check for Low Compression".

Low Compression (cylinder pressure)

1. Remove the fuel injectors from the cylinder head. Refer to Disassembly and Assembly, "Fuel Injector - Remove".
2. Perform a compression test on each cylinder. Refer to Systems Operation, Testing and Adjusting, "Compression - Test".
3. If necessary, investigate the cause of low compression.

Examples of low compression are shown in the following list:

- Loose glow plugs (if equipped)
- Mechanical problem
- Faulty piston rings
- Worn cylinder bores
- Worn valves
- Faulty cylinder head gasket
- Damaged cylinder head

4. If the vibration has not been eliminated, proceed to "Fuel Injectors".

Fuel Injectors

1. Remove the fuel injectors from the cylinder head. Refer to Disassembly and Assembly, "Fuel Injector - Remove".
2. Visually inspect the fuel injectors. If there is a suspected fault, replace the faulty fuel injector.
3. Install the fuel injectors. Refer to Disassembly and Assembly, "Fuel Injector - Install".
4. Ensure that the repairs have eliminated the fault.
5. If the vibration has not been eliminated, proceed to "Malfunctioning Individual Cylinder".

Malfunctioning Individual Cylinder

1. With the engine speed at a fast idle, loosen the high pressure fuel line to the fuel injector of number 1 cylinder. Note if there is any reduction in engine speed. Tighten the high pressure fuel line to the fuel injector.
2. Individually repeat this procedure for each fuel injector. If there is no reduction in the engine speed, investigate the cause of the malfunction.

i02595614

Engine Will Not Crank

Probable Causes

- Machine security system
- Battery cables and/or batteries
- Starting motor solenoid or starting circuit
- Starting motor and/or flywheel ring gear
- Electrical power supply
- Internal engine fault

Recommended Repairs

Machine Security System

1. Verify that the correct key is being used. Turn the key to the ON position.

2. Use the electronic service tool in order to check if diagnostic code 1639-09 is active. Verify that the lamp for the machine security system is on.
3. If the 1639-09 diagnostic code is active the machine security system is armed. Deactivate the machine security system and try to start the engine.
4. If the engine will not start use the electronic service tool to check for active diagnostic codes and logged diagnostic codes.
5. Investigate any active diagnostic codes and logged diagnostic codes and make all necessary repairs in order to eliminate the diagnostic codes.
6. If there are no active diagnostic codes or logged diagnostic codes, refer to the Troubleshooting Manual for your machine application.

Battery Cables and/or Batteries

1. Inspect the main power switch, battery posts, and battery cables for loose connections and corrosion. If the battery cables are corroded, remove the battery cables and clean the battery cables. Clean the battery posts. Replace the cables. Tighten any loose connections.
2. Inspect the batteries.
 - a. Charge the batteries.
 - b. Load test the batteries. Refer to Systems Operation, Testing and Adjusting, "Battery - Test".

Starting Motor Solenoid or Starting Circuit

1. Test the operation of the starting motor solenoid. Refer to Systems Operation, Testing and Adjusting, "Electric Starting System - Test".
2. Check the wiring to the starting motor solenoid.

Starting Motor and/or Flywheel Ring Gear

1. Test the operation of the starting motor. Check the wiring for the starting motor. Refer to Systems Operation, Testing and Adjusting, "Electric Starting System - Test".
2. Inspect the pinion on the starting motor and the flywheel ring gear for damage.

Electrical Power Supply

Check the electrical power supply. Refer to Troubleshooting, "Electrical Power Supply Circuit - Test".

Internal Engine Fault

1. Remove the glow plugs. Refer to Disassembly and Assembly, "Glow Plugs - Remove and Install".
2. Attempt to rotate the crankshaft through 360 degrees in both direction. If the crankshaft rotates correctly but fluid is expelled from the hole for the glow plug, investigate the cause of the fluid in the cylinder.
3. If the crankshaft rotates correctly and no fluid is expelled, install the glow plugs. Refer to Disassembly and Assembly, "Glow Plugs - Remove and Install".
4. If the engine does not rotate in Step 2, disassemble the engine. Refer to Disassembly and Assembly.
5. Inspect the internal components for the following conditions:
 - Seizure
 - Broken components
 - Bent components

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Excessive Black Smoke

Probable Causes

- Diagnostic codes
- ECM software
- Air intake system or exhaust system
- Valve lash
- Turbocharger (if equipped)
- Low compression (cylinder pressure)
- Individual malfunctioning cylinder
- Fuel injectors

Recommended Actions

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

ECM Software

1. Connect the electronic service tool to the diagnostic connector and check for the following conditions:
 - Check for the correct engine serial number
 - Check for the correct arrangement number
 - Check for the correct software
2. Use the electronic service tool to verify any active diagnostic codes.
3. If diagnostic codes are present, the ECM must be programmed with the correct information.
4. If the fault has not been eliminated, proceed to "Air Intake System or Exhaust System".

Air Intake System or Exhaust System

1. Check the air filter restriction indicator, if equipped.
2. Ensure that the air filter is clean and serviceable.
3. Check the air intake and the exhaust system for the following defects:
 - Blockages
 - Restrictions
 - Damage to the air intake and exhaust lines and hoses
4. Make all necessary repairs to the engine.
5. If the fault has not been eliminated, proceed to "Valve Lash".

Valve Lash

Ensure that the valve lash is correct. Reset the valve lash if it is not correct. Refer to Systems Operation, Testing and Adjusting, "Engine Valve Lash - Inspect/Adjust".

If the repair does not eliminate the fault, proceed to "Turbocharger (if equipped)".

Turbocharger (if equipped)

Note: The turbochargers that are used on 1100 Series engines are nonserviceable items. If any mechanical fault exists then the turbocharger must be replaced.

1. Ensure that the mounting bolts for the turbocharger are tight.

2. Check that the turbocharger drain is not blocked or restricted.
3. Check that the turbocharger housing is free of dirt and debris.
4. Check the turbocharger for worn bearings.
5. Check that the turbine blades rotate freely on the turbocharger.
6. Ensure that the wastegate on the turbocharger is adjusted correctly. Refer to Systems Operation, Testing and Adjusting, "Wastegate - Test". The adjustment of the wastegate is set by the factory. If the adjustment of the wastegate is incorrect then the turbocharger must be replaced.
7. Make all necessary repairs to the engine.
8. Ensure that the repairs have eliminated the faults.
9. If the repairs have not eliminated the fault proceed to "Low Compression (cylinder pressure)".

Low Compression (cylinder pressure)

Examples of low compression are shown in the following list:

- Loose glow plugs (if equipped)
 - Mechanical problem
 - Faulty piston rings
 - Worn cylinder bores
 - Worn valves
 - Faulty cylinder head gasket
 - Damaged cylinder head
1. Remove the fuel injectors and perform a compression test. Refer to Systems Operation, Testing and Adjusting, "Compression - Test" data.
 2. Make all necessary repairs to the engine.
 3. Ensure that the repairs have eliminated the faults.
 4. If the repair does not eliminate the fault proceed to "Individual Malfunctioning Cylinder".

Individual Malfunctioning Cylinder

1. With the engine speed at a fast idle, loosen the high pressure fuel line to the fuel injector of number 1 cylinder. Note if there is any reduction in engine speed. Tighten the high pressure fuel line to the fuel injector.

2. Repeat this procedure for each of the remaining fuel injector. If there is no reduction in the engine speed proceed to "Fuel Injectors".

Fuel Injectors

1. Remove the fuel injectors from the cylinder head. Refer to Disassembly and Assembly, "Fuel Injector - Remove".
2. Visually inspect the fuel injectors. If any fuel injector has a suspected fault, replace the fuel injector.
3. Install the fuel injectors into the cylinder head. Refer to Disassembly and Assembly, "Fuel Injector - Install".
4. Ensure that the repairs have eliminated the fault.

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Excessive Engine Oil Consumption

Probable Causes

- Misreading oil level
- Oil leaks
- Engine crankcase breather
- Oil level
- Air intake and exhaust system
- Turbocharger
- Low compression (cylinder pressure)

Recommended Actions

Misreading Oil Level

1. Accurately measure the consumption of oil and fuel over a period of 50 engine hours.
2. If the oil consumption is greater than 0.2% of the fuel consumption, use the following procedure in order to investigate the cause of the high oil consumption.

Oil Level

1. Check the oil level in the engine.

2. If the oil level is high, check for contamination of the oil with coolant. Refer to Troubleshooting, "Coolant in Engine Oil".
3. If no contamination is identified, remove any excess oil.
4. If the oil level is satisfactory, refer to "Oil Leaks".

Oil Leaks

1. Check for evidence of oil leaks on the engine.
2. Rectify any oil leaks from the engine.
3. Check for evidence of oil in the coolant.
4. If no oil leaks are identified, proceed to "Engine Crankcase Breather".

Engine Crankcase Breather

1. Check the engine crankcase breather for blockage or restrictions.
2. Check for excessive oil from the outlet of the breather.
3. Repair all defects. Verify that the repair has eliminated the fault.
4. If no faults are found, proceed to "Air Intake and Exhaust System".

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.
2. Ensure that the air filter is clean and serviceable.
3. Check the air intake and the exhaust system for the following defects:
 - Blockages
 - Restrictions
 - Damage to the air intake and exhaust lines and hoses
4. Make all necessary repairs to the engine.
5. Ensure that the repairs have eliminated the diagnostic code.
6. If no faults are found, refer to "Turbocharger".

Turbocharger

Note: The turbocharger that is installed on this engine is a nonserviceable item. If any mechanical fault exists, except for the wastegate actuator, then the turbocharger must be replaced.

1. Check that the oil drain for the turbocharger is not blocked or restricted.
2. Check the turbocharger for evidence of internal oil leaks.
3. If necessary, replace the turbocharger. Refer to Disassembly and Assembly, "Turbocharger - Remove" and Disassembly and Assembly, "Turbocharger - Install".
4. Check that the repairs have eliminated the faults.
5. If the repairs have not eliminated the fault proceed to "Low Compression (cylinder pressure)".

Low Compression (cylinder pressure)

1. Perform a compression test. Refer to Testing and Adjusting, "Compression - Test".
2. If low compression is noted on any cylinders, investigate the cause and rectify the cause.

Possible causes of low compression are shown in the following list:

- Loose glow plugs (if equipped)
 - Faulty piston
 - Worn piston rings
 - Worn cylinder bores
 - Worn valves
 - Faulty cylinder head gasket
 - Damaged cylinder head
3. Perform all necessary repairs.
 4. Ensure that the repairs have eliminated the faults.
 5. If the fault is not eliminated, refer to the Troubleshooting Manual for your engine application.

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Excessive Valve Lash

Note: This is not an electronic system fault.

Probable Causes

- Lubrication
- Valve train components
- Valve lash

Recommended Actions

Lubrication

1. Remove the valve mechanism cover. Refer to Disassembly and Assembly, "Valve Mechanism Cover - Remove and Install" for the correct procedure.
2. Crank the engine and check the lubrication in the valve compartment. Ensure that there is adequate engine oil flow in the valve compartment. The passages for the engine oil must be clean.

Note: Do not run the engine without the valve mechanism cover.

Valve Train Components

1. Inspect the following components of the valve train:
 - Rocker arms
 - Pushrods
 - Valve lifters
 - Camshaft
 - Valve stems
 - Rocker shafts
2. Check the components for the following conditions: abnormal wear, excessive wear, straightness, and cleanliness. If necessary, use new parts for replacement.

Note: If the camshaft is replaced, new valve lifters must also be used.

Valve Lash

Adjust the valve lash of the engine. Refer to Systems Operation, Testing and Adjusting, "Engine Valve Lash - Inspect/Adjust" for the correct procedure.

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Excessive White Smoke

Note: Some white smoke may be present during cold start-up conditions when the engine is operating normally. If the white smoke persists, there may be a fault.

Probable Causes

- Diagnostic codes
- Low coolant temperature
- Air inlet heater starting aid (if equipped)
- Glow plugs (if equipped)
- Fuel quality
- Valve lash
- Low compression (cylinder pressure)
- Individual malfunctioning cylinder

Recommended Actions

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

Low Coolant Temperature

Check that the water temperature regulator is operating correctly. Refer to Systems Operation, Testing and Adjusting, "Water Temperature Regulator - Test".

If the water temperature regulator is operating correctly, refer to "Air Inlet Heater Starting Aid (If Equipped)".

Air Inlet Heater Starting Aid (If Equipped)

1. Verify that the air inlet heater is operating correctly. Refer to Systems Operation, Testing and Adjusting, "Air Inlet Heater - Test".

2. If the repair does not eliminate the fault proceed to "Glow Plugs (If Equipped)".

Glow Plugs (If Equipped)

1. Check for proper operation of the glow plugs. Refer to Systems Operation, Testing and Adjusting, "Glow Plugs - Test".
2. If the repairs do not eliminate the fault refer to "Fuel Quality".

Fuel Quality

1. Check the diesel fuel for quality. Refer to Systems Operation, Testing and Adjusting, "Fuel Quality - Test".

Note: Diesel fuel with a low cetane value is likely to cause white smoke.

2. If the repair does not eliminate the fault refer to "Valve Lash".

Valve Lash

1. Ensure that the valve lash is correct. Refer to Systems Operation, Testing and Adjusting, "Engine Valve Lash - Inspect/Adjust".
2. If the repair does not eliminate the fault proceed to "Low Compression (cylinder pressure)".

Low Compression (cylinder pressure)

1. Perform a compression test. Refer to Systems Operation, Testing and Adjusting, "Compression - Test".
2. If low compression is noted on any cylinders, investigate the cause and rectify the cause.

Possible causes of low compression are shown in the following list:

- Loose glow plugs (if equipped)
- Faulty piston
- Faulty piston rings
- Worn cylinder bores
- Worn valves
- Faulty cylinder head gasket
- Damaged cylinder head

3. Perform all necessary repairs.
4. Ensure that the repairs have eliminated the faults.

5. If the repair does not eliminate the fault refer to "Individual Malfunctioning Cylinder".

Individual Malfunctioning Cylinder

1. With the engine speed at a fast idle, loosen the high pressure fuel line to the fuel injector of number 1 cylinder. Note if there is any reduction in engine speed. Tighten the high pressure fuel line to the fuel injector.
2. Repeat this procedure for each of the remaining fuel injectors.
3. Rectify any faults.

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Intake Air Temperature Is Too High

Probable Causes

- High ambient air temperature
- High intake air restriction and/or high altitude
- Intake air from a heated area
- Insufficient ambient air flow over the engine
- Insufficient flow of cooling water through the aftercooler (if equipped)
- Insufficient flow of air through the aftercooler (if equipped)

Recommended Repairs

High Ambient Air Temperature

Determine if the ambient air temperature is within the design specifications for the cooling system.

Determine the cause of the high air temperature. Make corrections, when possible.

Check for High Intake Air Restriction and/or High Altitude

When the pressure of the intake air is low, the turbocharger (if equipped) works harder in order to achieve the desired intake manifold pressure. This increases intake air temperature.

Measure the intake manifold pressure while the engine is operating under load. For specific data, refer to the Technical Marketing Information for the engine.

Intake Air Restriction

Check for plugged air filters. Check for obstructions in the air intake.

Replace the air filters and/or remove the obstruction from the air intake.

High Altitude

Make sure that the settings for the engine are correct for the altitude.

Intake Air from a Heated Area

1. Ensure that the air inlet system is not receiving air from a heated area.
2. If necessary, relocate the air supply to the intake manifold to the outside of the engine enclosure.
3. Check for air leaks in the pipe between the air inlet and the inlet to the turbocharger compressor.

Insufficient Ambient Air Flow over the Engine

1. If equipped, check the condition of the cooling fan and the drive belt.
2. If equipped, check that the cooling fan is operating correctly.

Check for Sufficient Coolant Flow Through the Aftercooler (if equipped)

Check the temperature of the coolant at the intake to the aftercooler. Compare the reading to the regulated temperature. If the temperature is OK, check the outlet temperature of the coolant. A high temperature differential indicates an insufficient flow rate.

If there is a high differential between the temperature of the coolant at the intake to the aftercooler and the temperature of the coolant at the outlet of the aftercooler, perform the following procedures:

- Check the coolant circuit of the aftercooler for obstructions.
- Check the pump for proper operation.
- Make repairs, if necessary.

Check for Sufficient Flow of Air Through the Aftercooler (if equipped)

Determine the pressure differential of the intake air across the aftercooler. For specific data, refer to the Technical Marketing Information for the engine.

If the pressure differential of the air across the aftercooler does not match the specifications, clean the aftercooler.

i02596822

Intermittent Engine Shutdown

Note: Use this procedure only if the engine shuts down completely and the engine must be restarted.

Probable Causes

- Diagnostic codes
- Engine protection device (if equipped)
- Electrical connectors
- Fuel supply

Recommended Actions

Diagnostic Codes

Check for any event and active diagnostic codes on the electronic service tool. Troubleshoot any active codes or logged codes before continuing with this procedure.

Engine Protection Device (if equipped)

1. Check if a warning lamp is ON.
2. Refer to Troubleshooting, "Indicator Lamp Circuit - Test".
3. Repair any faults and ensure that the engine protection device is not in operation.
4. If the fault has not been eliminated, proceed to "Electrical Connectors".

Electrical Connectors

1. Check for correct installation of ECM connectors at the following locations:
 - J1/P1 ECM connector
 - J20/P20 Machine interface connector

- J40/P40 Fuel injection pump connector
 - J100/P100 Engine coolant temperature sensor connector
 - J103/P103 Intake manifold air temperature sensor connector
 - J200/P200 Intake manifold pressure sensor connector
 - J201/P201 Engine oil pressure sensor connector
 - J401/P401 Speed/timing sensor connector
2. Refer to Troubleshooting, "Electrical Connectors - Inspect".
 3. Use the electronic service tool to check for the following logged diagnostic code: 253-02 "Incorrect ECM Software". If this diagnostic code is logged, proceed to Troubleshooting, "Electrical Power Supply Circuit - Test".
 4. Inspect the battery wires from the ECM back to the battery compartment. Inspect the wires and the power relay. Check the power and ground connections to the ECM. Refer to Troubleshooting, "Electrical Power Supply Circuit - Test" for more information.
 5. Check the P40 VP30 fuel pump connector. Refer to Troubleshooting, "Fuel Injection Pump Circuit - Test".
 6. Repair any faults and check that the fault has been eliminated. If the fault has not been eliminated, proceed to "Fuel Supply".

Fuel Supply

NOTICE

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

1. Check the fuel pressure. Refer to Systems Operation, Testing and Adjusting, "Fuel System Pressure - Test".
2. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
3. Check the diesel fuel for contamination. Refer to Systems Operation, Testing and Adjusting, "Fuel Quality - Test".
4. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".

5. Check that the fuel lines are tight and secured properly.
6. Check for fuel supply lines that are restricted.
7. Check the fuel filters.
8. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
9. If the engine has a water separator, check for water in the fuel.
10. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
11. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).

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Intermittent Low Power or Power Cutout

Note: Use this procedure only if the engine does not shut down completely.

Probable Causes

- Diagnostic codes
- Electrical connectors
- ECM connection
- Fuel supply
- Intake manifold pressure
- Throttle position sensor

Recommended Repairs

NOTICE

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

Electrical Connectors

1. Refer to Troubleshooting, "Electrical Connectors - Inspect".
2. Repair the electrical connectors or replace the electrical connectors.
3. Ensure that all the connector seals are in place and that the connectors have been correctly installed.
4. Ensure that the repairs have eliminated the fault. If the fault has not been eliminated proceed to "ECM Connection".

ECM Connection

1. Check that the J1/P1 connector is correctly connected.
2. Verify the proper pin positions for the power connections and the ground connections for the Electronic Control Module (ECM).
3. If a fault is suspected with the ECM power and ground connections refer to Troubleshooting, "Electrical Power Supply Circuit - Test".
4. Verify that the ECM connections for the power and ground connections at the fuel pump are connected properly.
5. If a fault is suspected with the fuel injection pump power and ground connections refer to Troubleshooting, "Fuel Injection Pump Circuit - Test".
6. Repair any faults and ensure that the faults have been eliminated.
7. If the repairs do not eliminate the faults, proceed to "Fuel Supply".

Fuel Supply

1. Check the fuel pressure. Refer to Systems Operation, Testing and Adjusting, "Fuel System Pressure - Test".
2. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".
3. Check the diesel fuel for contamination. Refer to Systems Operation, Testing and Adjusting, "Fuel Quality - Test".
4. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".

5. Check that the fuel lines are tight and secured properly.
6. Check for fuel supply lines that are restricted.
7. Check the fuel filters.
8. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
9. If the engine has a water separator, check for water in the fuel.
10. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
11. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).
12. If the repairs do not eliminate the faults, proceed to "Intake Manifold Pressure".

Intake Manifold Pressure

1. Use the electronic service tool to verify the intake manifold pressure.
2. Turn the keyswitch to the ON position.
3. Check the intake manifold pressure. The pressure should read 0 kPa (0 Psi).
4. Use the electronic service tool to check for the following logged diagnostic codes:
 - 102-03 Boost Pressure Sensor voltage above normal
 - 102-04 Boost Pressure Sensor voltage below normal

If either of these diagnostic codes are logged, proceed to Troubleshooting, "Engine Pressure Sensor Open or Short Circuit - Test".

5. If no faults are found proceed to "Throttle Position Sensor".

Throttle Position Sensor

1. Use the electronic service tool to observe the throttle position status.
2. Operate the engine at a maximum no-load speed. Check that the throttle position (%) is inside calibration (80 to 87%) at high idle if the programmed limit for the upper demand cannot be obtained.
3. If the engine speed is erratic, reduce the engine speed.

4. Check that the calibration of the low idle is within 20 to 27%.
5. Slowly increase the engine speed. Check that the engine speed is steady. Check that the position increases with more throttle.
6. Refer to Troubleshooting, "Throttle Position Circuit - Test".

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Low Engine Oil Pressure

NOTICE

Do not operate the engine with low oil pressure. Engine damage will result. If measured oil pressure is low, discontinue engine operation until the problem is corrected.

Probable Causes

- Engine oil level
- Oil specification
- Engine oil pressure gauge
- Engine oil filter
- Piston cooling jets
- Engine oil suction tube
- Engine oil pump
- Bearing clearance

Recommended Actions

Engine Oil Level

1. Inspect the engine oil level. If necessary, add oil.
2. If the fault is still apparent, refer to "Oil Specification".

Oil Specification

1. Make sure that engine oil of the correct specification is used. Refer to the Operation and Maintenance Manual, "Refill Capacities - Fluid Recommendations".
2. If necessary, drain the oil system and refill the oil system with engine oil of the correct specification. Refer to Operation and Maintenance Manual, "Engine Oil and Filter - Change".

3. If the fault is still apparent, refer to "Engine Oil Pressure Gauge".

Engine Oil Pressure Gauge

1. Check the actual engine oil pressure with a calibrated test gauge. Compare the oil pressure reading from the electronic service tool to the pressure on the test gauge.
2. If no difference is noted between the indicated oil pressures, refer to "Engine Oil Filter".

Engine Oil Filter

1. Remove the engine oil filter. Refer to the Operation and Maintenance Manual, "Engine Oil and Filter - Change".
2. Inspect the engine oil filter for evidence of blockage.
3. Install a new engine oil filter. Refer to the Operation and Maintenance Manual, "Engine Oil and Filter - Change".
4. If the fault is still apparent, refer to "Piston Cooling Jets".

Piston Cooling Jets

1. Inspect the piston cooling jets for damage. Replace any piston cooling jet that appears to be cracked, broken or missing. Refer to Disassembly and Assembly, "Piston Cooling Jets - Remove and Install".
2. If no damage is found, refer to "Engine Oil Suction Tube".

Engine Oil Suction Tube

1. Check the inlet screen on the oil suction tube and remove any material that may be restricting oil flow.
2. Check the joints of the oil suction tube for cracks or a damaged joint that may allow air leakage into the supply to the oil pump.
3. If no faults are found, refer to "Engine Oil Pump".

Engine Oil Pump

1. Inspect the components of the engine oil pump for excessive wear. Repair the oil pump or replace the oil pump, if necessary. Refer to Disassembly and Assembly, "Engine Oil Pump - Remove", Disassembly and Assembly, "Engine Oil Pump - Install" and Disassembly and Assembly, "Engine Oil Relief Valve - Remove and Install".

2. If no faults are found, refer to "Bearing Clearance".

Bearing Clearance

Inspect the engine components for excessive bearing clearance or damaged bearings. If necessary, replace the bearings and/or the components. Inspect the following components for excessive bearing clearance:

- Crankshaft main bearings
- Connecting rod bearings
- Camshaft front bearing
- Idler gear bearing

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Low Power/Poor or No Response to Throttle

Probable Causes

- Diagnostic codes
- ECM parameters
- Electrical connectors
- Electronic system
- Air intake and exhaust system
- Valve lash
- Turbocharger (if equipped)
- Fuel supply
- Low compression (cylinder pressure)
- Individual malfunctioning cylinders
- Fuel injectors

Recommended Actions

NOTICE

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

Diagnostic Codes

Check for active diagnostic codes on the electronic service tool. Troubleshoot any active codes before continuing with this procedure.

ECM Parameters

1. Ensure that the problem is not a parameter that has been incorrectly programmed.
2. Use the electronic service tool to ensure that the correct mode was selected.
3. Use the electronic service tool to verify that the correct engine rating has been provided.
4. Use the electronic service tool to verify the maximum engine speed limit.
5. Use the electronic service tool to reset the parameters to the OEM specifications.
6. Ensure that the repairs have eliminated the performance problems.
7. If the repairs have not eliminated the faults proceed to "Electrical Connectors".

Electrical Connectors

1. Check for correct installation of ECM connectors at the following locations:
 - J1/P1 ECM connector
 - J20/P20 Machine interface connector
 - J40/P40 Fuel injection pump connector
 - J100/P100 Engine coolant temperature sensor connector
 - J103/P103 Intake manifold air temperature sensor connector
 - J200/P200 Intake manifold pressure sensor connector
 - J201/P201 Engine oil pressure sensor connector
 - J401/P401 Speed/timing sensor connector
2. Refer to Troubleshooting, "Electrical Connectors - Inspect".
3. Use the electronic service tool to check for the following logged diagnostic code: 253-02 "Incorrect ECM Software". If this diagnostic code is logged, proceed to Troubleshooting, "Electrical Power Supply Circuit - Test".

4. Inspect the battery wires from the ECM back to the battery compartment. Inspect the wires and the power relay. Check the power and ground connections to the ECM. Refer to Troubleshooting, "Electrical Power Supply Circuit - Test" for more information.
5. Check the P40 VP30 fuel pump connector. Refer to Troubleshooting, "Fuel Injection Pump Circuit - Test".
6. Repair any faults and check that the fault has been eliminated. If the fault has not been eliminated, proceed to "Electronic System".

Electronic System

1. Turn the start switch to the ON position.
2. Use the electronic service tool to verify that the intake manifold pressure is 0 kPa (0 psi). Check the 5 V sensor supply for the intake manifold pressure. Refer to Troubleshooting, "5 Volt Engine Pressure Sensor Supply Circuit - Test".
3. Use the electronic service tool to verify the throttle position status.
4. Run the engine until the speed is equal to the maximum no-load speed.
5. If the maximum no-load speed can not be obtained refer to Troubleshooting, "Throttle Switch Circuit - Test" and Troubleshooting, "Mode Selection Circuit - Test".
6. If the engine speed is erratic refer to Troubleshooting, "Analog Throttle Position Sensor Circuit - Test" or Troubleshooting, "Digital Throttle Position Sensor Circuit - Test".
7. Repair any faults and check that the fault has been eliminated. If the fault has not been eliminated, proceed to "Air Intake and Exhaust System".

Air Intake and Exhaust System

1. Check the air filter restriction indicator, if equipped.
2. Ensure that the air filter is clean and serviceable.
3. Check the air intake and the exhaust system for the following defects:
 - Blockages
 - Restrictions
 - Damage to the air intake and exhaust lines and hoses
4. Make all necessary repairs to the engine.

5. Ensure that the repairs have eliminated the fault.
6. If the fault has not been eliminated, proceed to "Valve Lash".

Valve Lash

1. Check the valve lash and reset the valve lash, if necessary. Refer to Systems Operation, Testing and Adjusting, "Engine Valve lash - Inspect and Adjust".
2. If the repair does not eliminate the fault, proceed to "Turbocharger (if equipped)".

Turbocharger (if equipped)

Note: The turbochargers that are equipped on 1100 Series engines are nonserviceable items. If any mechanical fault exists then the turbocharger must be replaced.

1. Ensure that the mounting bolts for the turbocharger are tight.
2. Check that the turbocharger drain is not blocked or restricted.
3. Check that the turbocharger housing is free of dirt and debris.
4. Check the turbocharger for worn bearings. If any mechanical fault exists then the turbocharger should be replaced.
5. Check that the turbine blades rotate freely on the turbocharger.
6. Ensure that the wastegate on the turbocharger is adjusted correctly. Refer to Systems Operation, Testing and Adjusting, "Wastegate - Test". The adjustment to the wastegate is set at the factory. If the adjustment of the wastegate is incorrect then the turbocharger must be replaced.

7. Make all necessary repairs to the engine.
8. Ensure that the repairs have eliminated the faults.
9. If the fault has not been eliminated, proceed to "Fuel Supply".

Fuel Supply

1. Check the fuel pressure. Refer to Systems Operation, Testing and Adjusting, "Fuel System Pressure - Test".
2. Ensure that the fuel system has been primed. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime".

3. Check the diesel fuel for contamination. Refer to Systems Operation, Testing and Adjusting, "Fuel Quality - Test".
4. Check for air in the fuel system. Refer to Systems Operation, Testing and Adjusting, "Air in Fuel - Test".
5. Check that the fuel lines are tight and secured properly.
6. Check for fuel supply lines that are restricted.
7. Check the fuel filters.
8. Visually check the fuel tank for fuel. The fuel gauge may be faulty.
9. If the engine has a water separator, check for water in the fuel.
10. Ensure that the fuel supply valve (if equipped) is in the full OPEN position.
11. If the temperature is below 0 °C (32 °F), check for solidified fuel (wax).
12. If the repairs do not eliminate the fault, proceed to "Low Compression (Cylinder Pressure)".

Low Compression (Cylinder Pressure)

1. Perform a compression test. Refer to Systems Operation, Testing and Adjusting, "Compression - Test".
2. Make all necessary repairs to the engine.

Examples of low compression are shown in the following list:

- Loose glow plugs (if equipped)
 - Mechanical problem
 - Faulty piston rings
 - Worn cylinder bores
 - Worn valves
 - Faulty cylinder head gasket
 - Damaged cylinder head
3. Ensure that the repairs have eliminated the faults.
 4. If the repair does not eliminate the fault, proceed to "Individual Malfunctioning Cylinders".

Individual Malfunctioning Cylinders

1. With the engine speed at a fast idle, loosen the high pressure fuel line to the fuel injector of number 1 cylinder. Note if there is any reduction in engine speed. Tighten the high pressure fuel line to the fuel injector.
2. Individually repeat this procedure for each fuel injector.
3. If there is no reduction in the engine speed, proceed to "Fuel Injectors".

Fuel Injectors

1. Remove the fuel injectors from the cylinder head. Refer to Disassembly and Assembly, "Fuel Injector - Remove".
2. Visually inspect the fuel injectors. If any fuel injector has a suspected fault, replace the fuel injector.
3. Install the fuel injectors into the cylinder head. Refer to Disassembly and Assembly, "Fuel Injector - Install".
4. Ensure that the repairs have eliminated the fault.

i02598553

Mechanical Noise (Knock) in Engine

Probable Causes

- Accessory equipment
- Valve train components
- Pistons
- Connecting rod and main bearings

Recommended Actions

Accessory Equipment

1. Isolate the source of the noise. Remove the suspect engine accessory. Inspect the suspect engine accessory. Repair the engine accessory and/or replace the engine accessory if any defects are found.
2. If the mechanical noise is still apparent, refer to "Valve Train Components".

Valve Train Components

1. Remove the valve mechanism cover. Check the following items for damage: camshaft, valve springs, lifters, pushrods, and bridges. Thoroughly clean the valve train components. If the camshaft is being replaced, also replace the valve lifters. Ensure that all of the valves move freely. Replace any damaged parts.
2. If the mechanical noise is still apparent, refer to "Pistons".

Pistons

1. Inspect the pistons for damage and wear. Replace any damaged parts.
2. If the mechanical noise is still apparent, refer to "Connecting Rod and Main Bearings".

Connecting Rod and Main Bearings

Inspect the connecting rod and main bearings. Also, inspect the bearing surfaces (journals) on the crankshaft. Replace any damaged parts.

i02598558

Noise Coming from Cylinder

Probable Causes

- Fuel quality
- Valve lash
- Fuel injectors

Recommended Actions

Fuel Quality

Check the fuel quality. Remove unsatisfactory fuel from the fuel tank. Install new fuel filters. Use the proper grade of clean fuel in the fuel tank.

Valve Lash

Refer to Troubleshooting, "Excessive Valve Lash".

Fuel Injectors

1. Remove the fuel injectors from the cylinder head. Refer to Disassembly and Assembly, "Fuel Injector - Remove".

2. Visually inspect the fuel injectors. If a fuel injector has a suspected fault, replace the fuel injector.
3. Ensure that the repairs have eliminated the fault.

Troubleshooting with a Diagnostic Code

i02604671

Diagnostic Code Cross Reference

Table 13

CDL Code	Description	3rd Party Device J1939 Code	Flash Code
0041-03	8 Volt DC Supply voltage above normal	678-03	517
0041-04	8 Volt DC Supply voltage below normal	678-04	517
0091-02	Throttle Position Sensor erratic, intermittent, or incorrect	91-02	154
0091-03	Throttle Position Sensor voltage above normal	91-03	154
0091-04	Throttle Position Sensor voltage below normal	91-04	154
0091-08	Throttle Position Sensor abnormal frequency, pulse width, or period	91-08	154
0091-12	Accelerator pedal - power supply failure	91-08	154
0100-03	Engine Oil Pressure Sensor voltage above normal	100-03	157
0100-04	Engine Oil Pressure Sensor voltage below normal	100-04	157
0100-10	Engine Oil Pressure Sensor abnormal rate of change	100-10	157
0102-03	Boost Pressure Sensor voltage above normal	102-03	135
0102-04	Boost Pressure Sensor voltage below normal	102-04	135
0102-10	Boost Pressure Sensor abnormal rate of change	102-10	135
0105-03	Inlet Manifold Temperature Sensor voltage above normal	105-03	133
0105-04	Inlet Manifold Temperature Sensor voltage below normal	105-04	133
0110-03	Engine Coolant Temperature Sensor voltage below normal	110-03	168
0110-04	Engine Coolant Temperature Sensor voltage below normal	110-04	168
0174-02	Fuel Temperature Sensor erratic, intermittent, or incorrect	174-02	165
0247-09	SAE J1939 Data Link abnormal update rate	639-09	514
0253-02	Personality Module erratic, intermittent, or incorrect	631-02	415
0262-03	5 Volt Sensor DC Power Supply voltage above normal	1079-03	516
0262-04	5 Volt Sensor DC Power Supply voltage below normal	1079-04	516
0320-02	Speed/Timing Sensor Loss of Signal	637-02	141
0320-11	Speed/Timing Sensor mechanical failure	637-11	141
0342-02	Secondary Engine Speed Sensor erratic, intermittent, or incorrect	723-02	142
0774-02	Secondary Throttle Position Sensor erratic, intermittent, or incorrect	29-02	155
0774-03	Secondary Throttle Position Sensor voltage above normal	29-03	155
0774-04	Secondary Throttle Position Sensor voltage below normal	29-04	155
0774-08	Secondary Throttle Position Sensor abnormal frequency, pulse width, or period	29-08	155

(continued)

(Table 13, contd)

CDL Code	Description	3rd Party Device J1939 Code	Flash Code
0774-12	Secondary Throttle Position Sensor failure	29-12	155
1627-03	Fuel Pump Relay voltage above normal	1077-03	187
1684-00	Fuel Injection Pump high - most severe (3)	1077-00	158
1684-02	Fuel Injection Pump low - most severe (3)	1077-02	158
1684-03	Fuel Injection Pump voltage above normal	1077-03	158
1684-04	Fuel Injection Pump voltage below normal	1077-04	158
1684-05	Fuel Injection Pump current below normal	1077-05	158
1684-07	Fuel Injection Pump not responding properly	1077-07	158
1684-08	Fuel Injection Pump abnormal frequency, pulse width, or period	1077-08	158
1684-09	Fuel Injection Pump abnormal update rate	1077-09	158
1684-10	Fuel Injection Pump abnormal rate of change	1077-10	158
1684-11	Fuel Injection Pump other failure mode	1077-11	158
1684-12	Fuel Injection Pump failure	1077-12	158
1684-14	Fuel Injection Pump special instruction	1077-14	158
1743-02	Engine Operation Mode Selector Switch erratic, intermittent, or incorrect	2882-02	144
1894-02	Cruise Control Disengage Switch erratic, intermittent, or incorrect	2897-02	427
1895-02	Cruise Control Speed Toggle Switch erratic, intermittent, or incorrect	597-02	428
Event Codes			
E015	High Engine Coolant Temperature Derate	110-16	168
E016	High Engine Coolant Temperature Shutdown	110-00	168
E017	High Engine Coolant Temperature Warning	110-15	168
E025	High Intake Air Temperature Derate	105-16	133
E027	High Intake Air Temperature Warning	105-15	133
E040	Low Engine Oil Pressure Shutdown	100-01	157
E054	High Fuel Temperature Derate	174-16	165
E056	High Fuel Temperature Warning	174-15	165
E100	Low Engine Oil Pressure Warning	100-17	157
E190	Engine Overspeed Warning	190-15	141

i02601234

CID 0041 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The 8 volt supply is more than 8.8 VDC for more than one second.

- The ECM has been powered for more than three seconds.

System Response:

The ECM will log the diagnostic code and the check engine lamp will illuminate while this diagnostic code is active.

Possible Performance Effect:

The engine may be limited to low idle.

Note: The 8 volt supply may provide power to the digital throttle position sensor.

Troubleshooting:

Perform the following diagnostic procedure: "Digital Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02601235

CID 0041 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The 8 volt supply is less than 7.2 VDC for more than one second.
- The ECM has been powered for more than three seconds.

System Response:

The ECM will log the diagnostic code and the check engine lamp will illuminate while this diagnostic code is active. An active diagnostic code may not cause any noticeable effect on engine response unless the voltage drops below 6.5 VDC.

Possible Performance Effect:

Note: The 8 volt supply may provide power to the digital throttle position sensor.

Troubleshooting:

Perform the following diagnostic procedure: "Digital Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02601236

CID 0091 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) has detected an invalid combination of positions for the multi-position switches.

If the engine is equipped with an analog throttle position sensor then the signal from the idle validation switch is invalid.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

Possible Performance Effect:

The engine speed defaults to low idle or a predetermined safe speed.

The engine will remain at this speed while the diagnostic code remains active.

The reduction of speed is determined by the current speed of the engine.

When a fault is detected and the engine is above the predetermined safe speed, the engine will reduce speed to the safe speed.

When a fault is detected and the engine is below the predetermined safe speed, the engine speed will remain unchanged.

All throttle switch inputs are ignored by the ECM until the fault is repaired or until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Proceed to "Test Step 1" if the engine is equipped with a throttle switch.

Proceed to "Test Step 2" if the engine is equipped with an analog throttle position sensor.

Test Step 1.

Perform the following diagnostic procedure: "Throttle Switch Circuit - Test"

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: "Analog Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02601238

CID 0091 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- ECM has been powered for at least 3 seconds.
- The signal voltage for the throttle position is above the diagnostic upper limit that is set for the application.
- The power supply for the throttle sensor is within the expected range.

System Response:

If equipped, the warning light will come on. The ECM logs the diagnostic code if the engine is running. The diagnostic codes can be viewed on the electronic service tool. The ECM will return the engine to low idle.

Possible Performance Effect:

Throttle inputs are ignored by the ECM until the fault is repaired or until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to "Test Step 1".

If the engine is equipped with a digital throttle position sensor, proceed to "Test Step 2".

Test Step 1.

Perform the following diagnostic procedure: "Analog Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: "Digital Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02601239

CID 0091 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects all of the following conditions:

- The ECM has been powered for at least 3 seconds.
- The signal voltage for the throttle position is below the diagnostic lower limit that is set for the application.
- The power supply for the throttle sensor is within the expected range.

System Response:

If equipped, the warning light will come on. The ECM logs the diagnostic code if the engine is running. The diagnostic codes can be viewed on the electronic service tool. The ECM will return the engine to low idle.

Possible Performance Effect:

Throttle inputs are ignored by the ECM until the fault is repaired or until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to "Test Step 1".

If the engine is equipped with a digital throttle position sensor, proceed to "Test Step 2".

Test Step 1.

Perform the following diagnostic procedure: "Analog Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: "Digital Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02601242

CID 0091 FMI 08

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal frequency from the accelerator pedal position sensor is less than 150 Hz or the signal frequency is greater than 1050 Hz for more than two seconds.
- The ECM has been powered for at least three seconds.
- Diagnostic code 0091-03 is not active.
- Diagnostic code 0091-04 is not active.
- Diagnostic codes for the 8 volt sensor supplies are not active.

System Response:

Limp home mode is activated.

The ECM sets the "Throttle Position" to "0%". "DIAG" will be displayed next to the status for "Throttle Position" on the electronic service tool.

If equipped, the warning light will be on. The diagnostic code will be logged if the engine is running. The diagnostic code will not be logged if the engine is cranking.

Possible Performance Effect:

The engine will remain at low idle while the diagnostic code is active.

Throttle inputs are ignored by the ECM until the fault is repaired or until the keyswitch has been turned to the OFF position and then back to the ON position.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

This diagnostic code indicates that the frequency of a digital throttle signal is out of the normal range.

Perform the following diagnostic procedure: "Digital Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02600484

CID 0091 FMI 12

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- A failure of the 5 volt DC supply to the accelerator pedal
- Diagnostic code 0262-04 is not active.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will return the engine to the low idle or to the predetermined safe speed while the diagnostic code remains active.

Possible Performance Effect:

- Low power
- Reduced engine speed

Troubleshooting:

Perform the following diagnostic procedure: "Analog Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02601249

CID 0100 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the engine oil pressure sensor is greater than 4.95 VDC for more than eight seconds.
- The ECM has been powered for at least two seconds.
- The engine is not running or the engine coolant temperature is greater than 38 °C (100 °F).

System Response:

The ECM will log the diagnostic code. If equipped, the warning lamp will come on. The ECM will set data for engine oil pressure to the default value.

Note: The engine oil pressure that is displayed on the electronic service tool is the default value for engine oil pressure. The default engine oil pressure is 600 kPa (87 psi). The electronic service tool will display "Voltage Above Normal" on the status screens.

Possible Performance Effect:

None

Troubleshooting:

This diagnostic code can be caused by an open circuit or a short to another power source.

Perform the following diagnostic procedure: "Engine Pressure Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i02601255

CID 0100 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the engine oil pressure sensor is less than 0.1 VDC for more than eight seconds.
- The ECM has been powered for at least two seconds.
- The engine is running.

System Response:

The ECM will log the diagnostic code. If equipped, the warning lamp will come on. The ECM will set data for engine oil pressure to the default value. The electronic service tool will display "Voltage Below Normal" on the status screens.

Possible Performance Effect:

None

Troubleshooting:

This code can be caused by a short to ground or a shorted sensor.

Perform the following diagnostic procedure: "Engine Pressure Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i02601258

CID 0100 FMI 10

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- No other codes for the oil pressure sensor are active.
- No 0262 diagnostic codes are active for the 5 Volt supply.
- The engine speed is greater than 600 rpm.
- The engine oil pressure signal is within the limits of 410 kPa (59 psi) to 520 kPa (75 psi) with a pressure variation of less than 1.68 kPa (0.25 psi) for more than 30 seconds.
- The engine oil pressure signal remains constant for 30 seconds.

System Response:

If equipped, the warning lamp will be on.

The ECM will log the diagnostic code. The diagnostic code can be viewed on the electronic service tool.

The ECM will flag the engine oil pressure as invalid data.

The data for engine oil pressure is set to a default value of 500 kPa (72 psi).

The electronic service tool will display "Conditions Not Met" on the status screen.

Possible Performance Effect:

None

Troubleshooting:

This diagnostic code is designed to detect the loss of the 5 Volt supply to the sensor.

Perform the following diagnostic procedure: "Engine Pressure Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i02601264

CID 0102 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects all of the following conditions:

- The ECM reads a signal voltage that is above normal.
- The ECM has been powered for at least fifteen seconds.
- CID 262-03 5 Volt Sensor DC Power Supply voltage above normal and CID 262-04 5 Volt Sensor DC Power Supply voltage below normal are not active.

System Response:

The ECM will set the intake manifold pressure to a default value.

The electronic service tool will display "Open/Short High" for the intake manifold pressure on the status screen.

The ECM will generate a CID 102 FMI 03 diagnostic code on the Data Link. The diagnostic code will be displayed on a diagnostic screen of the electronic service tool.

Possible Performance Effect:

The engine could have low power while the diagnostic code is active.

Perform the following diagnostic procedure: "Engine Pressure Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i02601315

CID 0102 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects all of the following conditions:

- The ECM detects a signal voltage that is below normal.
- The ECM has been powered for at least fifteen seconds.
- CID 262-03 5 Volt Sensor DC Power Supply voltage above normal and CID 262-04 5 Volt Sensor DC Power Supply voltage below normal are not active.

System Response:

The ECM will set intake manifold pressure to a default value.

The electronic service tool will display "Short to Ground" for the intake manifold pressure on the status screen.

The ECM will generate a CID 102 FMI 04 diagnostic code on the Data Link. The diagnostic code will be displayed on a diagnostic screen of the electronic service tool.

Possible Performance Effect:

The engine could have low power while the diagnostic code is active.

Perform the following diagnostic procedure: "Engine Pressure Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i02601321

CID 0102 FMI 10

Conditions Which Generate This Code:

If the 5 volt connection to the sensor is an open circuit, this fault will result in a logged code.

The Electronic Control Module (ECM) detects all of the following conditions:

- No other CID 0262 or CID 0102 codes are active.
- The engine speed is greater than 1000 rpm.
- The pressure sensor signal from the intake manifold is within the expected range for this failure mode.
- The pressure sensor signal from the intake manifold remains abnormally constant because the variations in the sensor signal are too small.
- All of the above conditions occur simultaneously for a period of 30 seconds.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool. The ECM will flag the intake manifold pressure as data that is abnormal or incorrect. The intake manifold pressure is set to a default value.

Perform the following diagnostic procedure: "Engine Pressure Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i02601363

CID 0105 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects all of the following conditions:

- The ECM reads signal voltage that is above normal.
- The ECM has been powered for at least fifteen seconds.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool. The ECM flags the intake air temperature as data that is abnormal or incorrect and a default value is used.

Possible Performance Effect:

- Low power
- Poor cold starting

Troubleshooting:

Perform the following diagnostic procedure: "Engine Temperature Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i02601371

CID 0105 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects all of the following conditions:

- The ECM reads signal voltage that is below normal.
- The ECM has been powered for at least fifteen seconds.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool. The ECM flags the intake air temperature as data that is abnormal or incorrect and a default value is used.

Possible Performance Effect:

- Low power
- Poor cold starting

Troubleshooting:

Perform the following diagnostic procedure: "Engine Temperature Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i02601881

CID 0110 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the engine coolant temperature sensor is greater than 4.95 VDC for more than eight seconds.
- The ECM has been powered for at least two seconds.

System Response:

If equipped, the warning light will be on. An active diagnostic code will be generated after 8 seconds. The diagnostic code will be logged if the engine has been operating for more than 7 minutes.

The ECM will default to 90 °C (194 °F) for engine coolant temperature. "Voltage Above Normal" will be displayed next to the status for "Engine Coolant Temperature" on the electronic service tool.

Possible Performance Effect:

- Poor stability
- Poor cold running
- White smoke

Troubleshooting:

Perform the following diagnostic procedure: "Engine Temperature Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i02601882

CID 0110 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The signal voltage from the engine coolant temperature sensor is less than 0.2 VDC for more than eight seconds.

- The ECM has been powered for at least two seconds.

System Response:

The ECM will default to 90 °C (194 °F) for engine coolant temperature. "Voltage Below Normal" will be displayed next to the status for "Engine Coolant Temperature" on the electronic service tool.

If equipped, the warning light will come on. An active diagnostic code will be generated after 8 seconds. The diagnostic code will be logged if the engine has been operating for more than 7 minutes. When the diagnostic code is logged, the ECM will trigger a snapshot.

Possible Performance Effect:

- Poor stability
- Poor cold running
- White smoke

Troubleshooting:

Perform the following diagnostic procedure: "Engine Temperature Sensor Open or Short Circuit - Test"

Results:

- OK – STOP.

i02601883

CID 0174 FMI 02

Conditions Which Generate This Code:

Note: If both of the following diagnostic codes are active, then the fuel injection pump has suffered a complete failure of the electrical supply:

- 174-02
- 342-02

Both of the diagnostic codes will be active if there has been a communication fault between the Electronic Control Module (ECM) and the CAN Data Link for the fuel injection pump. When only one of the diagnostic codes is active there is not a fault with the electrical supply for the fuel injection pump.

If the ECM has detected 174-02 only, then one of the following conditions has been detected:

- The fuel temperature signal is erratic.
- The fuel temperature signal is intermittent.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool. The ECM logs the diagnostic code only if the engine is running.

Possible Performance Effect:

- The engine may shut down.
- The engine will have low power.

Troubleshooting:

Further troubleshooting is required.

Perform the following diagnostic procedure: "Fuel Injection Pump Circuit - Test"

Results:

- OK – STOP.

CID 0247 FMI 09

i02601884

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following condition:

- Another controller has stopped transmitting a J1939 speed request (TSC1) incorrectly or another controller has started transmitting a J1939 speed request incorrectly.

System Response:

Some system functions may not operate correctly.

Troubleshooting:

Perform the following diagnostic procedure: "CAN Data Link Circuit - Test"

Results:

- OK – STOP.

CID 0253 FMI 02

i02601886

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects incorrect engine software.

System Response:

If equipped, the warning light will come on.

This diagnostic code is not logged.

Factory passwords are required to clear this diagnostic code.

Possible Performance Effect:

The engine will not start.

Troubleshooting:

The flash file in the ECM is from the wrong engine family.

Use the electronic service tool to install the correct flash file into the ECM. Refer to the Troubleshooting Guide, "Flash Programming".

Perform the following diagnostic procedure: "None"

Results:

- OK – STOP.

CID 0262 FMI 03

i02601888

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The 5 volt supply is greater than 5.16 VDC for more than one second.
- The ECM has been powered for at least three seconds.

System Response:

The ECM sets all of the pressure sensors and temperature sensors to the default values.

The ECM will derate the engine.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

Perform the following diagnostic procedure: "5 Volt Engine Pressure Sensor Supply Circuit - Test"

Results:

- OK – STOP.

i02601889

CID 0262 FMI 04**Conditions Which Generate This Code:**

The Engine Control Module (ECM) detects the following conditions:

- The 5 volt supply is less than 4.84 VDC for more than one second.
- The ECM has been powered for at least three seconds.

System Response:

The ECM sets all of the pressure sensors and temperature sensors to the default values.

The ECM will derate the engine.

Possible Performance Effect:

The engine will be derated.

Troubleshooting:

Perform the following diagnostic procedure: "5 Volt Engine Pressure Sensor Supply Circuit - Test"

Results:

- OK – STOP.

i02601913

CID 0320 FMI 02**Conditions Which Generate This Code:**

The signal for the speed/timing sensor is intermittent. The speed/timing sensor is located near the flywheel housing.

System Response:

The Electronic Control Module (ECM) will use the speed/timing sensor in the fuel injection pump to determine engine speed. The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

Possible Performance Effect:

There may be a slight change in engine response.

The ECM will limit the maximum engine speed to 1200 rpm.

If the signal is lost from both of the engine speed/timing sensors, the ECM will shut down the engine.

Perform the following diagnostic procedure: "Engine Speed/Timing Sensor Circuit - Test"

Results:

- OK – STOP.

i02602017

CID 0320 FMI 11**Conditions Which Generate This Code:**

The signal for the speed/timing sensor is lost. The speed/timing sensor is located near the flywheel housing.

System Response:

The Electronic Control Module (ECM) will use the speed/timing sensor in the fuel injection pump to determine engine speed. The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

Possible Performance Effect:

There may be a slight change in engine response.

The ECM will limit the maximum engine speed to 1200 rpm.

If the signal is lost from both of the engine speed/timing sensors, the ECM will shut down the engine.

Perform the following diagnostic procedure: "Engine Speed/Timing Sensor Circuit - Test"

Results:

- OK – STOP.

i02602618

i02602619

CID 0342 FMI 02

Conditions Which Generate This Code:

Note: If both of the following diagnostic codes are active, then the fuel injection pump has suffered a complete failure of the electrical supply:

- 0174-02
- 0342-02

Both of the diagnostic codes will be active if there has been a communication fault between the Electronic Control Module (ECM) and the CAN data link for the fuel injection pump. If only the 0342-02 is active there is not a fault with the electrical supply for the fuel injection pump.

The signal for the speed/timing sensor in the fuel injection pump is intermittent or lost for less than one second.

System Response:

The Electronic Control Module (ECM) will log the diagnostic code. The ECM will force the engine to a default value or a safe speed. The diagnostic code may be viewed on the electronic service tool.

Possible Performance Effect:

The engine will shut down.

Test Step 1.

Perform the following diagnostic procedure: "Fuel Injection Pump Circuit - Test"

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: "CAN Data Link Circuit - Test"

Results:

- OK – STOP.

CID 0774 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a position for the throttle switch that has not been defined.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will return the engine to low idle or to a safe speed while the diagnostic code is active.

Possible Performance Effect:

The engine speed defaults to low idle or a predetermined safe speed.

The engine will remain at this speed while the diagnostic code remains active.

The reduction of speed is determined by the current speed of the engine.

When a fault is detected and the engine is above the predetermined safe speed, the engine will reduce speed to the safe speed.

When a fault is detected and the engine is below the predetermined safe speed, the engine will match the correct speed.

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

The engine will use the primary throttle only until the fault is repaired.

Perform the following diagnostic procedure: "Throttle Switch Circuit - Test"

Results:

- OK – STOP.

i02603383

CID 0774 FMI 03

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The ECM has been powered for 3 seconds.
- No 0262 diagnostic codes are active.
- The setting for the upper diagnostic limit has been exceeded for 1 second.
- On an engine with an analog throttle, the signal voltage from the position sensor is more than 4.75 volts DC.
- On an engine with a digital (PWM) throttle, the signal voltage from the position sensor is more than 95 percent or 1050 Hz.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will return the engine to low idle or to a safe speed while the diagnostic code is active.

Possible Performance Effect:

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to "Test Step 1".

If the engine is equipped with a digital (PWM) throttle position sensor, proceed to "Test Step 2".

Test Step 1.

Perform the following diagnostic procedure: "Analog Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: "Digital Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02603398

CID 0774 FMI 04

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The ECM has been powered for 3 seconds.
- No 0262 diagnostic codes are active.
- The setting for the lower diagnostic limit has been exceeded for 1 second.
- On an engine with an analog throttle, the signal voltage from the position sensor is less than 0.25 volts DC.
- On an engine with a digital (PWM) throttle, the signal voltage from the position sensor is less than 5 percent or 150 Hz.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will return the engine to low idle or to a safe speed while the diagnostic code is active.

Possible Performance Effect:

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to "Test Step 1".

If the engine is equipped with a digital (PWM) throttle position sensor, proceed to "Test Step 2".

Test Step 1.

Perform the following diagnostic procedure: "Analog Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: "Digital Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02603456

CID 0774 FMI 08

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The ECM has been powered for 3 seconds.
- No 0262 codes are active for the analog sensors.
- No 0041 codes are active for the digital (PWM) sensors.
- Diagnostic codes 0774-03 and 0774-04 are not active.
- The frequency of the signal from the digital (PWM) sensor is less than 150 Hz for more than 1 second.
- The frequency of the signal from the digital (PWM) sensor is greater than 1050 Hz for more than 1 second.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will return the engine to low idle or to a safe speed while the diagnostic code is active.

Possible Performance Effect:

Throttle inputs are ignored by the ECM until the fault is repaired.

Throttle inputs will also be ignored by the ECM until the keyswitch has been turned to the OFF position and then back to the ON position.

The engine will default to the limp home mode.

If a second throttle is installed, the engine will use the second throttle until the fault is repaired.

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to "Test Step 1".

If the engine is equipped with a digital (PWM) throttle position sensor, proceed to "Test Step 2".

Test Step 1.

Perform the following diagnostic procedure: "Analog Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: "Digital Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02603458

CID 0774 FMI 12

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects one of the following conditions:

- An abnormal throttle position sensor signal
- Failure of the throttle position sensor

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will return the engine to low idle or to a safe speed while the diagnostic code is active.

Possible Performance Effect:

- Low power
- Reduced engine speed

Troubleshooting:

Monitor the configuration screen on the electronic service tool in order to determine the type of throttle position sensor that is used on the engine.

If the engine is equipped with an analog throttle position sensor, proceed to "Test Step 1".

If the engine is equipped with a digital throttle position sensor, proceed to "Test Step 2".

Test Step 1.

Perform the following diagnostic procedure: "Analog Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

Test Step 2.

Perform the following diagnostic procedure: "Digital Throttle Position Sensor Circuit - Test"

Results:

- OK – STOP.

i02603461

CID 1627 FMI 03**Conditions Which Generate This Code:**

The Electronic Control Module (ECM) still receives signals from the fuel injection pump even though the ECM has already switched the relay to the Off position.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

Possible Performance Effect:

None

Perform the following diagnostic procedure: "Fuel Injection Pump Circuit - Test"

Results:

- OK – STOP.

i02603615

CID 1684 FMI 00**Conditions Which Generate This Code:**

This code is generated by the fuel injection pump.

There are two conditions that will generate this code:

- The fuel temperature may be above the recommended maximum operating temperature. The recommended maximum operating fuel temperature is 70 °C (158.0 °F) at the inlet to the fuel injection pump. The electronic fuel injection pump will note that the fuel temperature is too high.
- There may be an internal fault within the fuel injection pump.

System Response:

The Electronic Control Module (ECM) will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The fuel injection pump will reduce the available quantity of fuel for injection if the fuel temperature is too high and the diagnostic code is still active. E054 High Fuel Temperature Derate is the event code that will be logged on the ECM.

Possible Performance Effect:

- The engine will be derated.
- Low engine power
- Reduced engine speed

Test Step 1.

Check the fuel system for restrictions.

Check the fuel temperature.

Check for active diagnostic codes

Results:

- OK – STOP.

Test Step 2.

If the fault has not been eliminated refer to Systems Operation, Testing and Adjusting, “Fuel System - Inspect”.

Results:

- OK – STOP.

If the fault persists, contact your Perkins distributor in order to change the fuel injection pump. The warranty of the fuel injection pump will be affected if the pump is replaced without prior consultation.

Replace the fuel injection pump. Refer to Disassembly and Assembly, “Fuel Injection Pump - Remove” and Disassembly and Assembly, “Fuel Injection Pump - Install”.

Check that the fault has been eliminated.

Results:

- OK – STOP.

i02603663

i02603653

CID 1684 FMI 02

Conditions Which Generate This Code:

This diagnostic code is generated by the fuel injection pump.

The fuel injection pump will detect the following condition:

- An internal failure of the fuel injection pump software.

System Response:

The Electronic Control Module (ECM) will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will not allow the engine to start while the diagnostic code is active.

If the engine is running and the diagnostic code becomes active, the ECM will cause the engine to shutdown.

Possible Performance Effect:

The ECM will cause the engine to shutdown.

The engine will not start while the diagnostic code is active.

Troubleshooting:

Contact your Perkins distributor in order to check if the software version is correct. Also check that there have been no software updates.

CID 1684 FMI 03

Conditions Which Generate This Code:

This code is generated by the fuel injection pump.

The fuel injection pump will detect the following condition:

- An internal problem with the fuel injection pump

The Electronic Control Module (ECM) will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

System Response:

The ECM will have no response to this active code. The engine may have reduced power.

Possible Performance Effect:

An incorrect amount of fuel may be injected into the cylinders. Continuing to use the engine under these conditions may lead to engine failure.

Troubleshooting:

Contact your Perkins distributor in order to check if the software version is correct. Also check that there have been no software updates.

If the fault persists, contact your Perkins distributor in order to change the fuel injection pump. The warranty of the fuel injection pump will be affected if the pump is replaced without prior consultation.

Replace the fuel injection pump. Refer to Disassembly and Assembly, “Fuel Injection Pump - Remove” and Disassembly and Assembly, “Fuel Injection Pump - Install”.

Check that the fault has been eliminated.

Results:

- OK – STOP.

i02604435

CID 1684 FMI 04**Conditions Which Generate This Code:**

This diagnostic code is generated by the fuel injection pump.

The fuel injection pump detects one of the following conditions while the engine is running:

- Supply voltage below normal
- Intermittent signal

The Electronic Control Module (ECM) will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

System Response:**Possible Performance Effect:**

The diagnostic code is logged, but there will be no other system response.

- There is no obvious effect on engine performance.

Perform the following diagnostic procedure: "Fuel Injection Pump Circuit - Test"

Results:

- OK – STOP.

i02604436

CID 1684 FMI 05**Conditions Which Generate This Code:**

The Electronic Control Module (ECM) detects the following condition:

- Invalid "CAN A" signal in the fuel injection pump

The invalid "CAN A" signal is likely to be caused by a fault in the fuel injection pump.

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will cause the fuel injection pump to stop injecting fuel and the engine will shut down while the diagnostic code is active.

Troubleshooting:

- A.** Contact your Perkins distributor in order to change the fuel injection pump. The warranty of the fuel injection pump will be affected if the pump is replaced without prior consultation.

Replace the fuel injection pump. Refer to Disassembly and Assembly, "Fuel Injection Pump - Remove" and Disassembly and Assembly, "Fuel Injection Pump - Install".

- B.** Check that the fault has been eliminated.

Results:

- OK – STOP.

i02604437

CID 1684 FMI 07**Conditions Which Generate This Code:**

This code is generated by the fuel injection pump.

The Electronic Control Module (ECM) will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

System Response:

The ECM will cause the fuel injection pump to stop injecting fuel and the engine will shut down while the diagnostic code is active.

Possible Performance Effect:

The engine will shut down.

Troubleshooting:

Refer to Troubleshooting, "Fuel Injection Pump Circuit - Test".

Check for active diagnostic codes.

Results:

- OK – STOP.

i02604438

CID 1684 FMI 08

Conditions Which Generate This Code:

This code is generated by the fuel injection pump.

The fuel injection pump detects one of the following conditions:

- The fuel injection pump did not receive a position signal.
- The signal that is received by the fuel injection pump is incorrect.

The Electronic Control Module (ECM) will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

System Response:

The fuel injection pump will provide open loop engine timing. The ECM will derate the engine power by 20% while the diagnostic code is active.

Possible Performance Effect:

The engine can experience any of the following conditions:

- Small loss of engine performance
- Increased emissions
- The engine may be difficult to start.

Troubleshooting:

Further troubleshooting is required.

Test Step 1.

Check for the following active code:

- Diagnostic code 320-02
- Diagnostic code 320-11

Results:

- Codes Active – Proceed to Test Step 2.

Test Step 2.

Perform the following diagnostic procedure: “Engine Speed/Timing Sensor Circuit - Test”

Results:

- OK – STOP.
- Not OK – Proceed to Test Step 3.

Test Step 3.

Inspect the electrical harness on the engine.

Pay close attention to the following areas:

- P1/J1 ECM connector
- P40/J40 Fuel injection pump connector
- P1:59 Engine position
- P40:8 Engine position

Refer to Troubleshooting, “Electrical Connectors - Inspect”.

Results:

- OK – Proceed to Test Step 4.

Test Step 4.

Check continuity between the following connections:

- P1:59 Engine position
- P40:8 Engine position

Expected Result:

If the fault is eliminated, then STOP.

If the fault still exists, Inspect the harness in order to identify the cause of the fault.

Repair the wire harness or replace the wire harness.

Check that the repairs have eliminated the fault.

Results:

- OK – STOP.

i02604439

CID 1684 FMI 09

Conditions Which Generate This Code:

This code is generated by the fuel injection pump.

The fuel injection pump detects one of the following conditions:

i02604440

- Failure of the CAN A data link
- The Electronic Control Module (ECM) sends incorrect data.
- The fuel injection pump sends incorrect data.

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

System Response:

The ECM will cause the fuel injection pump to stop the injection of fuel.

Possible Performance Effect:

The ECM will cause the following conditions:

- The engine will shut down.
- The engine will not start.

Troubleshooting:

Further troubleshooting is required.

Test the circuit for the CAN data link. Refer to Troubleshooting, "CAN Data Link Circuit - Test".

Expected Result:

If the fault is eliminated, then STOP.

If the fault is still active, connect a test ECM in order to eliminate the original ECM as the cause of the problem. Refer to Troubleshooting, "Replacing the ECM".

Note: The parameters of the test ECM must match the parameters in the suspect ECM. If the test ECM resolves the problem, reconnect the suspect ECM. Verify that the problem returns. If the problem returns, replace the suspect ECM.

If the fault is eliminated, then STOP.

If the fault is still active, contact your Perkins distributor before the fuel injection pump is replaced. The warranty of the fuel injection pump will be affected if the pump is replaced without prior consultation.

Replace the fuel injection pump. Refer to Disassembly and Assembly, "Fuel Injection Pump - Remove" and Disassembly and Assembly, "Fuel Injection Pump - Install".

Check that the fault has been eliminated.

Results:

- OK – STOP.

CID 1684 FMI 10

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects one of the following improper responses from the fuel injection pump.

- An open circuit
- A wire shorted high.
- A wire shorted low.

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

System Response:

The engine may shut down while the diagnostic code is active. Also, the engine may not start while the diagnostic code is active.

Troubleshooting:

Further troubleshooting is required.

Test Step 1.

Use a multimeter to check between the following connections:

- J1:1
- P40:5

Note: While the engine is cranking and running, the battery voltage at terminal P40:5 should drop to 0 volts.

Ensure that the fault has been eliminated.

Results:

- Check for active diagnostic codes – STOP.

Test Step 2.

Connect a test ECM to the engine in order to determine if the original ECM is causing the problem. Refer to Troubleshooting, "Replacing the ECM".

Note: The parameters of the test ECM must match the parameters in the suspect ECM. If the test ECM resolves the fault, reconnect the suspect ECM. Verify that the fault returns. If the fault returns, replace the suspect ECM.

Results:

- OK – STOP.
- Not OK – Proceed to Test Step 3.

Test Step 3.

Contact your Perkins distributor before the fuel injection pump is replaced. The warranty for the fuel injection pump will be affected if the pump is replaced without prior consultation.

Replace the fuel injection pump. Refer to Disassembly and Assembly, "Fuel Injection Pump - Remove" and Disassembly and Assembly, "Fuel Injection Pump - Install".

Check that the fault has been eliminated.

Results:

- OK – STOP.

i02604442

CID 1684 FMI 11

Conditions Which Generate This Code:

This code is generated by the fuel injection pump.

The problem is internal to the fuel injection pump.

There may be air in the fuel injection pump.

The voltage and/or resistance at the connectors for the fuel injection pump are incorrect.

The Electronic Control Module (ECM) will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

System Response:

The ECM will derate the engine power by 20% while the diagnostic code is active.

Possible Performance Effect:

The engine may experience any of the following conditions while the diagnostic code remains active:

- Low power
- Reduced engine speed

Troubleshooting:

Further troubleshooting is required.

Test Step 1.

Check the tightness of all fuel line connections. Check for air in the fuel injection pump. Refer to Operation and Maintenance Manual, "Fuel System - Prime".

Results:

- OK – Proceed to Test Step 2.

Test Step 2.

Refer to Troubleshooting, "Fuel Injection Pump Circuit - Test".

Check that the fault has been eliminated.

Results:

- OK – STOP.

i02604445

CID 1684 FMI 12

Conditions Which Generate This Code:

This diagnostic code is generated by the fuel injection pump.

The problem is internal to the fuel injection pump.

The Electronic Control Module (ECM) will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

System Response:

The ECM will derate the engine power by 20% while the diagnostic code is active.

Possible Performance Effect:

While the diagnostic code is active the engine will experience the following conditions:

- Low power
- Reduced engine speed

Troubleshooting:

Contact your Perkins distributor in order to check if the software version is correct. Also check that there have been no software updates.

If the fault still exists, contact your Perkins distributor before the fuel injection pump is replaced. The warranty of the fuel injection pump will be affected if the pump is replaced without prior consultation.

Replace the fuel injection pump. Refer to Disassembly and Assembly, "Fuel Injection Pump - Remove" and Disassembly and Assembly, "Fuel Injection Pump - Install".

Check that the fault has been eliminated.

Results:

- OK – STOP.

i02604531

CID 1684 FMI 14

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a communication failure with the fuel injection pump. The communication failure may be due to disconnected connectors for the fuel injection pump or a faulty wiring harness for the fuel injection pump.

System Response:

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

Possible Performance Effect:

The 1684-14 diagnostic code will not have any effect on the performance of the engine. Diagnostic code 1684-14 is normally accompanied by diagnostic code 0174-02 or 0320-02. Diagnostic code 0174-02 may cause the engine to have low power. If diagnostic code 0320-02 is active, the ECM will limit the engine rpm to 1200 rpm.

Troubleshooting:

Further troubleshooting is required.

Test Step 1.

Perform the following diagnostic procedure: "CAN Data Link Circuit - Test"

Results:

- OK – STOP.
- Not OK – Proceed to Test Step 2.

Test Step 2.

Connect a test ECM in order to determine if the fault is in the original ECM or in the fuel injection pump. Refer to Troubleshooting, "Replacing the ECM".

Note: The parameters of the test ECM must match the parameters in the suspect ECM. If the test ECM resolves the fault, reconnect the suspect ECM. Verify that the fault returns. If the fault returns, replace the suspect ECM.

Check that the fault has been eliminated.

Results:

- OK – STOP.
- Not OK – Proceed to Test Step 3.

Test Step 3.

Contact your Perkins distributor in order to check if the software version is correct. Also check that there have been no software updates.

If the fault still exists, the fuel injection pump must be replaced. Contact your Perkins distributor before the fuel injection pump is replaced. The warranty of the fuel injection pump will be affected if the pump is replaced without prior consultation. Refer to Disassembly and Assembly, "Fuel Injection Pump - Remove" and Disassembly and Assembly, "Fuel Injection Pump - Install".

Check that the fault has been eliminated.

Results:

- OK – STOP.

i02604535

CID 1743 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects a combination of switch positions for the mode switches that has not been defined.

System Response:

The ECM will return the engine to the last good mode selection or setting.

Possible Performance Effect:

The engine will start and the engine will default to the previous mode selection. The engine may operate at reduced speed or reduced power. This will depend on the mode that is selected.

Troubleshooting:

Further troubleshooting is required.

Perform the following diagnostic procedure: "Mode Selection Circuit - Test"

Results:

- OK – STOP.

i02604557

CID 1894 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects one of the following conditions:

- Erratic data
- Intermittent data
- Incorrect data

System Response:

The engine speed fails to disengage from the set speed.

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will have no response to this active diagnostic code. There is no loss of engine performance.

Troubleshooting:

Further troubleshooting is required.

Refer to Troubleshooting, "Throttle Switch Circuit - Test".

Results:

- OK – STOP.

i02604657

CID 1895 FMI 02

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects one of the following conditions:

- Erratic data
- Intermittent data
- Incorrect data

System Response:

The engine speed fails to disengage from the set speed.

The ECM will log the diagnostic code. The diagnostic code may be viewed on the electronic service tool.

The ECM will have no response to this active diagnostic code. There is no loss of engine performance.

Troubleshooting:

Further troubleshooting is required.

Refer to Troubleshooting, "Throttle Switch Circuit - Test".

Results:

- OK – STOP.

Troubleshooting with an Event Code

Event Codes

i02605250

The Electronic Control Module (ECM) can log events. Events refer to engine operating conditions such as low oil pressure or high coolant temperature. Logged events usually indicate a mechanical problem instead of an electronic system problem.

Note: If a diagnostic code has already been logged, any event code that is associated with that fault will not be logged.

Programmable Engine Parameters

The following features may be programmed:

- Engine Warning
- Engine Derate
- Engine Shutdown

When the features are activated the event will be logged in the ECM.

i02630564

E015 High Engine Coolant Temperature Derate

Conditions Which Generate This Code:

- The engine has been running for at least 3 minutes.
- The engine coolant temperature has exceeded the trip point and the delay time has expired.

System Response:

The alarm output is activated. The event is logged.

Possible Performance Effect:

The engine power is reduced.

Troubleshooting:

Refer to Troubleshooting, "Coolant Temperature Is Too High".

Results:

- OK – STOP.

i02630567

E016 High Engine Coolant Temperature Shutdown

Conditions Which Generate This Code:

- The engine has been running for at least 3 minutes.
- The engine coolant temperature has exceeded the trip point and the delay time has expired.

System Response:

If the engine shutdown is "ENABLED" the fuel will be shut off. The event will be logged.

Possible Performance Effect:

The engine is shut down.

Troubleshooting:

Refer to Troubleshooting, "Coolant Temperature Is Too High".

Results:

- OK – STOP.

i02630568

E017 High Engine Coolant Temperature Warning

Conditions Which Generate This Code:

- The engine has been running for at least 3 minutes.
- The engine coolant temperature has exceeded the trip point and the delay time has expired.

System Response:

The alarm output is activated. The event is logged.

Possible Performance Effect:

The engine operation is not immediately affected. However, if the coolant temperature continues to rise, the engine will be derated.

Troubleshooting:

Refer to Troubleshooting, "Coolant Temperature Is Too High".

Results:

- OK – STOP.

i02605391

E025 High Inlet Air Temperature Derate

Conditions Which Generate This Code:

- The engine has been running for at least 3 minutes.
- The inlet air temperature has exceeded the setpoint and the delay time has expired.
- No other codes for the inlet manifold air temperature are active.

System Response:

The alarm output is activated. The event is logged.

Possible Performance Effect:

The engine power is reduced.

Troubleshooting:

Refer to Troubleshooting, "Intake Air Temperature Is Too High".

Results:

- OK – STOP.

i02605251

E027 High Inlet Air Temperature Warning

Conditions Which Generate This Code:

- The engine has been running for at least 3 minutes.
- The inlet manifold air temperature has exceeded the trip point for the application and the delay time of 4 seconds has expired.
- No other codes for the intake manifold air temperature are active.

The ECM detects the following conditions:

- The inlet manifold air temperature is greater than 76 °C (168 °F) for the 1106 engine.
- The inlet manifold air temperature is greater than 135 °C (275 °F) for the 1104 turbocharged engine.
- The inlet manifold air temperature is greater than 82 °C (179 °F) for the aftercooled 1104 turbocharged engine.
- The inlet manifold air temperature is greater than 112 °C (233 °F) for the 1104 naturally aspirated engine.

The ECM will reset when the following conditions are met:

- The inlet manifold air temperature is less than 74 °C (165 °F) for the 1106 engine.
- The inlet manifold air temperature is less than 133 °C (271 °F) for the 1104 turbocharged engine.
- The inlet manifold air temperature is less than 80 °C (176 °F) for the aftercooled 1104 turbocharged engine.
- The inlet manifold air temperature is less than 110 °C (230 °F) for the 1104 naturally aspirated engine.

System Response:

The alarm output is activated. The code is logged.

Possible Performance Effect:

The ECM will derate the engine. The ECM will continue to derate the engine at a higher rate as the inlet manifold air temperature rises.

Troubleshooting:

Refer to Troubleshooting, "Intake Air Temperature Is Too High".

Results:

- OK – STOP.

i02605252

E040 Low Engine Oil Pressure Shutdown

Conditions Which Generate This Code:

The Electronic Control Module (ECM) detects the following conditions:

- The engine has been running for at least 5 seconds.
- The engine speed is above 350 rpm.
- The engine oil pressure is less than 100 kPa (14.5 psi).
- The two second delay time has expired.
- No 0100 diagnostic codes for the engine oil pressure sensor are active.

System Response:

The code is logged. The ECM will reset the shutdown when the oil pressure rises 21 kPa (3 psi) above the low pressure trip point for 20 seconds. In order to manually reset the event code, turn the keyswitch to the OFF position and then turn the keyswitch to the ON position. If the engine shutdown input is "ENABLED" and there is no rise in oil pressure above the trip point, the fuel will be shut off after the two second delay has expired.

Possible Performance Effect:

The engine is shut down.

Troubleshooting:

Refer to Troubleshooting, "Low Engine Oil Pressure".

Results:

- OK – STOP.

i02605253

E054 High Fuel Temperature Derate

Conditions Which Generate This Code:

- The engine has been running for at least 3 seconds.

- The fuel temperature is above the trip point for the application.

System Response:

The warning lamp will flash while the "Derate" is active.

The electronic service tool will display "Engine Derate" in the first engine status box on the electronic service tool status screen.

The Electronic Control Module (ECM) will generate a E054 event code on the data link. The event code will be displayed on a diagnostic screen of the electronic service tool.

Troubleshooting:

- There may be a problem with the fuel system.
- There may be a problem with the fuel temperature sensor.

Test Step 1. Check for Diagnostic Codes

- Connect the electronic service tool to the diagnostic connector.
- Turn the keyswitch to the ON position. Do not start the engine.
- Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

There should be no diagnostic codes that are present.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair any faults that have generated diagnostic codes. Refer to the appropriate topic in Troubleshooting, "Troubleshooting With a Diagnostic Code".

Ensure that the repair has eliminated the fault.

STOP.

Test Step 2. Check the Fuel System

- Perform a check of the fuel system. Refer to the appropriate topic in Systems Operation, Testing and Adjusting for possible causes.

Expected Result:

There are no faults in the fuel system.

Results:

- OK – There may be an intermittent fault.

Repair: Monitor the operation of the engine.

If an intermittent fault is identified, repair the fault.

Ensure that the repair has eliminated the fault.

STOP.

- Not OK

Repair: Perform a further investigation of the fault.

Ensure that any repair has eliminated the fault.

STOP.

i02605254

E056 High Fuel Temperature Warning

Conditions Which Generate This Code:

The fuel temperature has exceeded the trip point and the delay time has expired. The Electronic Control Module (ECM) will reset the warning when the fuel temperature is above the reset value.

The ECM detects all of the following conditions:

- The engine has been running at least three minutes. This three minute delay begins once the engine speed is within 50 rpm of the low idle setting.
- Diagnostic code 0174-02 is not active.

System Response:

The ECM will log the event. The event code can be viewed on the diagnostic screen of the electronic service tool.

Troubleshooting:

- There may be a problem with the fuel system.
- There may be a problem with the fuel temperature sensor.

Test Step 1. Check for Diagnostic Codes

- A.** Connect the electronic service tool to the diagnostic connector.

- B.** Turn the keyswitch to the ON position. Do not start the engine.

- C.** Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

There should be no diagnostic codes that are present.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair the fault that has generated the diagnostic code. Refer to the appropriate topic in Troubleshooting, "Troubleshooting with a Diagnostic Code".

Ensure that the repair has eliminated the fault.

STOP.

Test Step 2. Check the Fuel System

- A.** Perform a check of the fuel system. Refer to the appropriate topic in Systems Operation, Testing and Adjusting for possible causes.

Expected Result:

There are no faults in the fuel system.

Results:

- OK – There may be an intermittent fault.

Repair: Monitor the operation of the engine.

If an intermittent fault is identified, repair the fault.

Ensure that the repair has eliminated the fault.

STOP.

- Not OK

Repair: Perform a further investigation of the fault.

Ensure that any repair has eliminated the fault.

STOP.

i02605259

E100 Low Engine Oil Pressure Warning

Conditions Which Generate This Code:

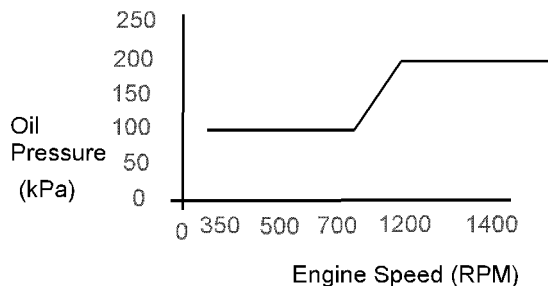


Illustration 19

g01028820

Oil pressure map for the 1104 engine

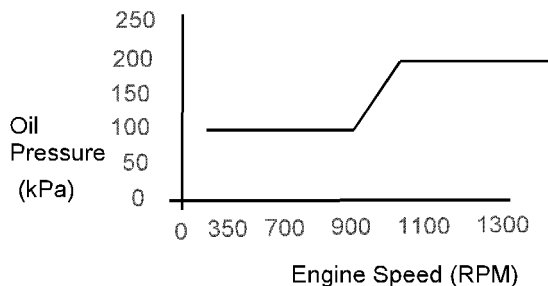


Illustration 20

g01028718

Oil pressure map for the 1106 engine

The Electronic Control Module (ECM) detects the following conditions:

- The engine has been running for at least 5 seconds.
- The engine speed is at least 350 rpm.
- Engine oil pressure is lower than the threshold for low oil pressure for more than 2 seconds.
- 100-03 "Engine Oil Pressure open/short to +batt" is not active.
- 100-04 "Engine Oil Pressure short to ground" is not active.
- 100-10 Engine Oil Pressure Sensor abnormal rate of change is not active.

System Response:

The ECM will log the event. The ECM will reset the warning when the oil pressure rises 21 kPa (3 psi) above the threshold for at least four seconds.

Possible Performance Effect:

- None

Troubleshooting:

- There may be a problem with the engine lubrication system.
- There may be a problem with the engine oil pressure sensor.

Test Step 1. Check for Active Diagnostic Codes

A. Start the electronic service tool.

B. Turn the keyswitch to the ON position.

C. Check for any active diagnostic codes or logged diagnostic codes.

Expected Result:

There should be no diagnostic codes that are present.

Results:

- OK – There are no diagnostic codes that are present. Proceed to test step 2.
- Not OK – There are diagnostic codes that are present.

Repair: Repair the faults that generated the diagnostic codes. Refer to the appropriate topic in Troubleshooting, "Troubleshooting with a Diagnostic Code". Ensure that the repair has eliminated the fault.

STOP.

Test Step 2. Check the Engine Lubrication System

A. Perform a check of the engine lubrication system. Refer to Troubleshooting, "Low Engine Oil Pressure".

Expected Result:

There are no faults in the engine lubrication system.

Results:

- OK – There are no faults in the engine lubrication system. There may be an intermittent fault.

Repair: Monitor the operation of the engine. If an intermittent fault is identified, repair the fault. Ensure that the repair has eliminated the fault.

STOP.

- Not OK – There is a fault in the engine lubrication system.

Repair: Repair the fault. Ensure that the repair has eliminated the fault.

STOP.

i02605279

E190 Engine Overspeed Warning

Conditions Which Generate This Code:

- On 1104 engines, the engine speed is above 3000 rpm for more than 0.6 seconds.
- On 1106 engines, the engine speed is above 3300 rpm for more than 0.6 seconds.

Note: The reset point for both the 1104 and 1106 engines is 2800 RPM.

Note: This event code represents an event. This does not represent an electronic system fault.

System Response:

The event is logged in memory. The event may be viewed on a display module or the electronic service tool.

Possible Performance Effect:

None

Troubleshooting:

This event indicates excessive engine speed. This does not represent a problem with the Engine Control Module (ECM). This does not represent a problem with the engine speed/timing sensor.

Engine Overspeed Warning

This event records the engine overspeed warning. No troubleshooting is required.

Expected Result:

Results:

- OK – STOP.

Diagnostic Functional Tests

i02605757

5 Volt Engine Pressure Sensor Supply Circuit - Test

System Operation Description:

Use this procedure if another procedure has directed you here. Also use this procedure if any of the following diagnostic codes are active:

- 262-03 5 Volt Sensor DC Power Supply voltage above normal
- 262-04 5 Volt Sensor DC Power Supply voltage below normal

The following background information is related to this procedure:

The Electronic Control Module (ECM) supplies regulated +5 VDC to the following sensors:

- J40/P40 Throttle Sensor
- J200/P200 Intake Manifold Pressure Sensor
- J201/P201 Engine Oil Pressure Sensor

The supply for the +5 volt engine pressure sensor is routed from the ECM through ECM engine harness connector J1/P1 terminal 26 to terminal "A" of each pressure sensor connector. The supply voltage is 5.0 $\pm$ 0.5 VDC.

The diagnostic code is probably caused by a short circuit or an open circuit in the harness. The next probable cause is a sensor and the least probable cause is the ECM.

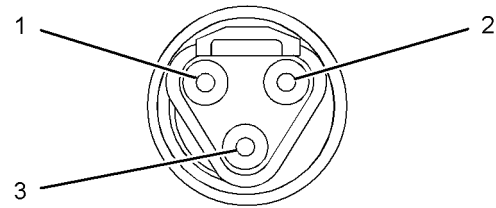
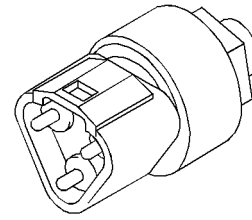


Illustration 22

g01304533

Engine oil pressure sensor

- (1) Sensor Common
- (2) 5 Volt Sensor Supply
- (3) Engine Oil Pressure Signal

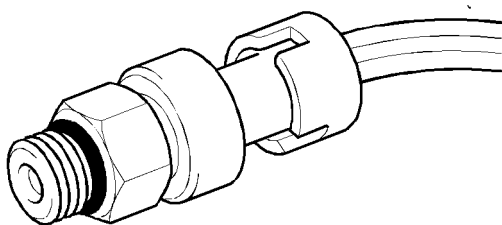


Illustration 21

g00884730

Intake manifold pressure sensor

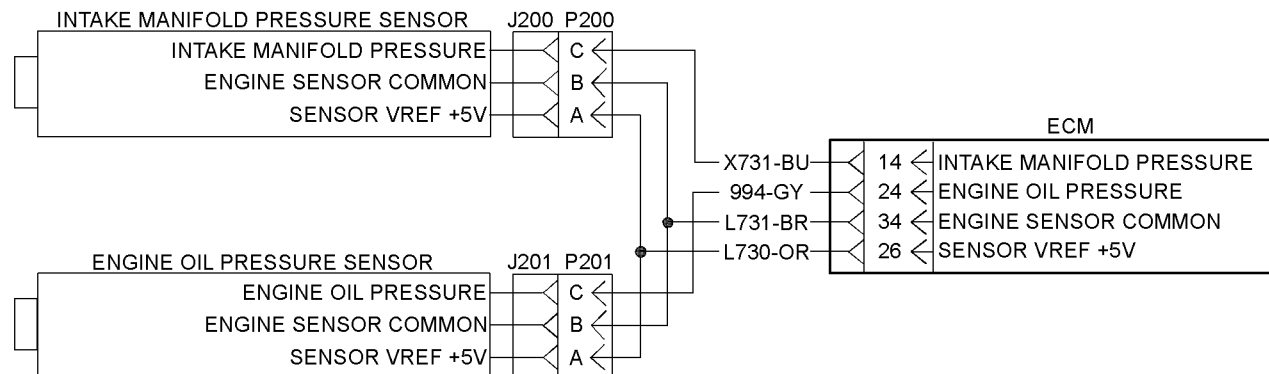


Illustration 23

g01304537

Schematic of the 5 volt supply for the engine pressure sensors

Test Step 1. Inspect Electrical Connectors And Wiring.

A. Thoroughly inspect the following connections:

- P1/J1 ECM engine harness connector
- P20/J20 MIC machine harness connector
- P200/J200 Intake manifold pressure sensor
- P201/J201 Engine oil pressure sensor

Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.

- P1-14 Intake Manifold Pressure
- P1-24 Engine Oil Pressure
- P1-26 Sensor VRef +5V
- P1-34 Engine Sensor Common

Refer to Illustration 24.

C. Check the ECM connector (Allen head screw) for the correct torque of 6.0 N·m (55 lb in).

D. Check the harness and wiring for abrasion and pinch points from the sensors to the ECM.

Expected Result:

All connectors, pins and sockets should be completely coupled and/or inserted and the harness and wiring should be free of corrosion, abrasion or pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK

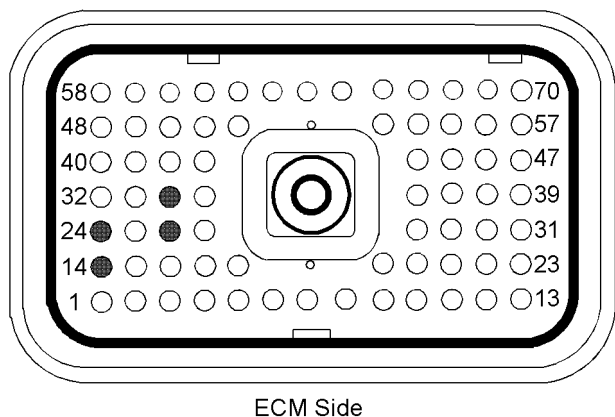
Repair: Repair the connectors or wiring and/or replace the connectors or wiring. Ensure that all of the seals are properly in place and ensure that the connectors are completely coupled.

Verify that the repair eliminates the fault.

STOP.

Test Step 2. Check for Active Diagnostic Codes

- Connect the electronic service tool to the diagnostic connector.
- Turn the keyswitch to the ON position. Do not start the engine.



ECM Side

Illustration 24

g01304561

- (14) Intake manifold pressure
- (24) Engine oil pressure
- (26) Sensor VRef +5V
- (34) Engine sensor common

B. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the +5 volt sensor supply:

- C. Monitor the active diagnostic code screen on the electronic service tool. Check and record any active diagnostic codes.

Note: Wait at least 15 seconds in order for the diagnostic codes to become active.

Expected Result:

Select the condition of the following codes:

- 262-03 5 Volt Sensor DC Power Supply voltage above normal
- 262-04 5 Volt Sensor DC Power Supply voltage below normal

Results:

- Active – Proceed to Test Step 3.
- Logged ONLY – Proceed to Test Step 5.
- Not Active or Logged – The +5 volt supply is operating correctly. STOP.

Test Step 3. Disconnect The ECM Engine Harness Connector From The ECM

- A. Connect the electronic service tool to the diagnostic connector.

 WARNING

Batteries give off flammable fumes which can explode.

To avoid injury or death, do not strike a match, cause a spark, or smoke in the vicinity of a battery.

NOTICE

Do not connect the bypass harness to the battery until the 10 Amp in-line fuse has been removed from the Battery + line. If the fuse is not removed before connection to the battery, a spark may result.

- B. Turn the keyswitch to the OFF position.

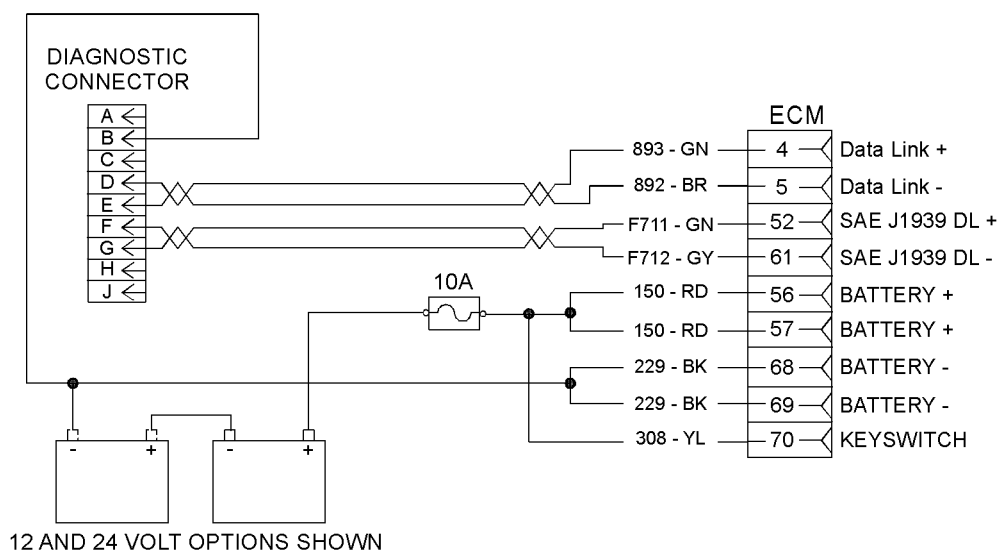


Illustration 25

g01304602

- C. Refer to Troubleshooting, "Engine Wiring Information" for wiring instructions.
 - D. Disconnect J1/P1 ECM engine harness connector.
 - E. Connect the J1 bypass harness to the ECM connector.
 - F. Remove the fuse F1 from the bypass harness and from the battery circuit.
 - G. Connect the unswitched battery cables directly to the battery terminals.
 - H. Install the F1 fuse to the in-line fuse holder.
- Note:** The bypass harness directly connects the keyswitch circuit to the ECM. The ECM will have power until the connection to the battery + cable is disconnected. Remove the "F1" fuse from the in-line fuse holder in order to isolate the ECM.
- I. Turn the keyswitch to the ON position. Do not start the engine.
 - J. Access the active diagnostic code screen on the electronic service tool. Check for one of the following active diagnostic codes:
 - 262-03 5 Volt Sensor DC Power Supply voltage above normal
 - 262-04 5 Volt Sensor DC Power Supply voltage below normal

Note: When ECM engine harness connector J1/P1 is disconnected and the keyswitch is in the ON position, open circuit diagnostic codes will be "Active" or "Logged" for all of the engine sensors. This is normal.

Expected Result:

The +5 volt diagnostic code is active when the ECM engine harness connector is disconnected.

Results:

- OK – The +5 volt diagnostic code is active when the ECM engine harness connector is disconnected.

Repair: Temporarily connect a test ECM to the engine J20/P20. The test ECM should be programmed with the same values and with the same parameters as the suspect ECM. Recheck for a +5 volt diagnostic code. If a +5 volt diagnostic code is not active, the original ECM is faulty. Reconnect the original ECM and check the +5 volt diagnostic codes. If a +5 volt diagnostic code becomes active, replace the ECM. If the ECM is replaced, the new ECM should be programmed with the same values and with the same parameter as the suspect ECM.

STOP.

- Not OK – The +5 volt sensor diagnostic code is no longer active when the harness is disconnected. Either the harness or a sensor that is attached to the harness is causing the problem. Reconnect the ECM engine harness connector. Proceed to Test Step 4.

Test Step 4. Disconnect The +5 V Sensors While Active Diagnostic Codes Are Being Monitored

- A. Connect the electronic service tool to the diagnostic connector.

- B.** Turn the keyswitch to the ON position. Do not start the engine.
- C.** Access the active diagnostic code screen on the electronic service tool. Verify that one of the following diagnostic codes is active:
- 262-03 5 Volt Sensor DC Power Supply voltage above normal
 - 262-04 5 Volt Sensor DC Power Supply voltage below normal
- D.** Disconnect the following sensors one at a time:
- Intake manifold pressure sensor J200/P200
 - Engine oil pressure sensor J201/P201
- E.** Wait for 30 seconds after each pressure sensor is disconnected while the electronic service tool is being monitored in order to verify that the disconnection of a specific sensor deactivates the +5 volt diagnostic code.

Note: When the sensors are disconnected and the keyswitch is in the ON position, open circuit diagnostic codes will be active or logged when the +5 volt diagnostic codes are no longer active. This is normal. Clear these diagnostic codes after this test step is completed.

Expected Result:

The original +5 volt diagnostic code remains active.

Results:

- OK – The +5 volt diagnostic code is still active. The harness is the cause of the fault. Leave the sensors disconnected. Proceed to Test Step 5.
- Not OK – The +5 volt diagnostic code is not active when a specific sensor is disconnected.

Repair: Reconnect the suspect sensor. If the fault returns after the reconnection of the sensor, disconnect the sensor. If the fault disappears after the disconnection of the sensor, replace the sensor.

Clear all diagnostic codes. Verify that the repair eliminates the fault.

STOP.

Test Step 5. Check the Engine Harness

- A.** Turn the keyswitch to the OFF position. Do not start the engine.

- B.** Disconnect ECM connector J1/P1. Verify that all of the following +5 volt engine pressure sensors that are attached to the ECM connectors are disconnected.
- Intake manifold pressure sensor J200/P200
 - Engine oil pressure sensor J201/P201
- C.** Measure the resistance from P1-26 +5 Volt Engine Pressure Sensor to each of the following terminals:
- P1:14 Intake manifold pressure
 - P1:24 Engine oil pressure
- a.** Wiggle the harness during the measurement in order to reveal any intermittent short condition.

Expected Result:

Each resistance measurement is more than 20 ohms.

Results:

- OK – The +5 volt line is not shorted in the engine harness. Ensure that the engine harness is connected to the ECM and that all of the sensors are reconnected. There does not appear to be a fault. Clear all diagnostic codes. Continue to troubleshoot until the original condition is resolved. STOP.
- Not OK

Repair: Replace the engine harness. Clear all logged diagnostic codes. Verify that the repair eliminates the fault.

STOP.

i02606332

Air Inlet Heater Circuit - Test

System Operation Description:

Use this procedure if another procedure has made reference to this procedure. Also use this procedure under the following circumstances:

- Failure of the power supply to the starting aid
- A failure of the starting aid

There are two types of starting aid that equip 1100 Series engines. The 1104 engine uses glow plugs. The 1106 engine uses an air inlet heater.

The starting aid is used to improve the engine starting when the engine is cold. A reduction of white smoke is also a benefit of the starting aid.

The Electronic Control Module (ECM) uses a relay to control the operation of the starting aid.

(X) = TEST POINT

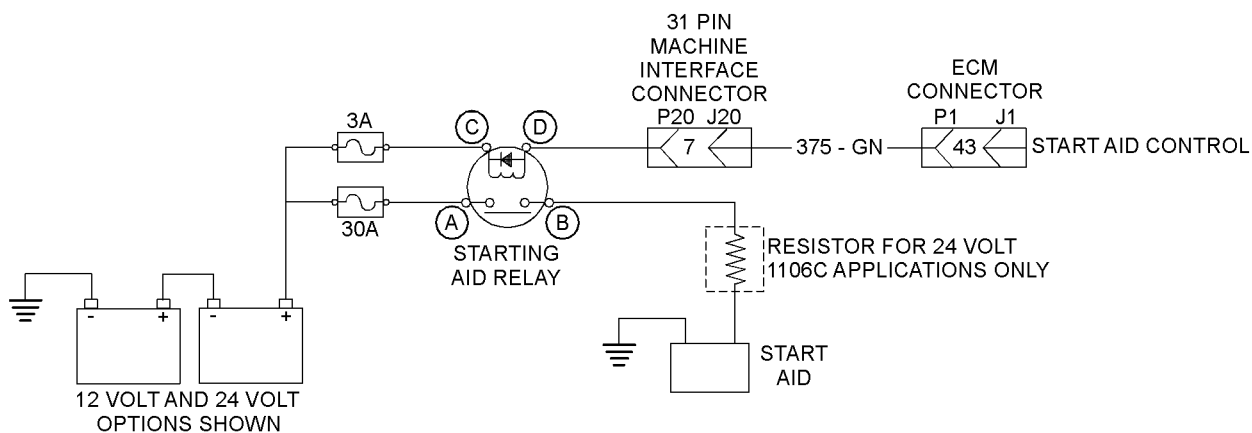


Illustration 26
Schematic for the starting aid (31 pin MIC)

g01304876

(X) = TEST POINT

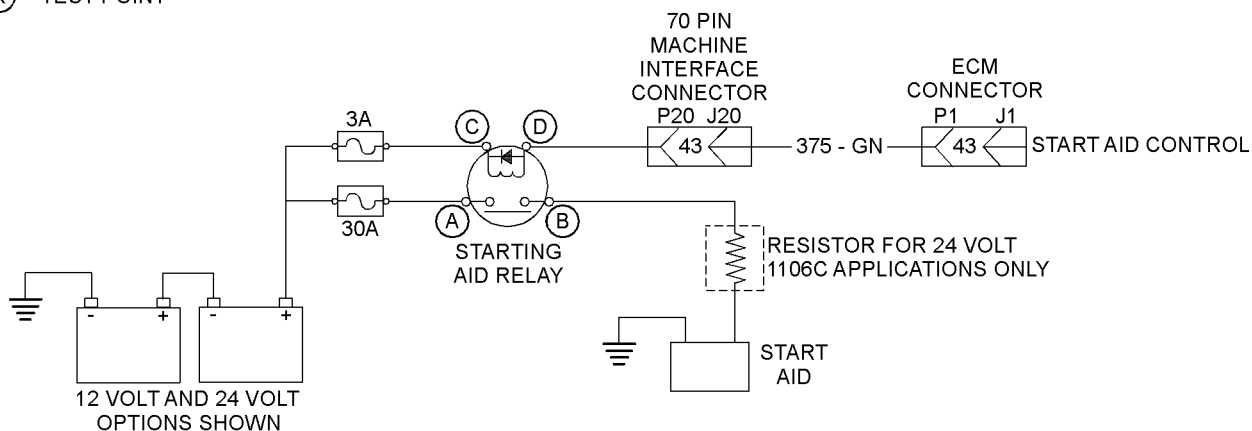


Illustration 27
Schematic for the starting aid (70 pin MIC)

g01305786

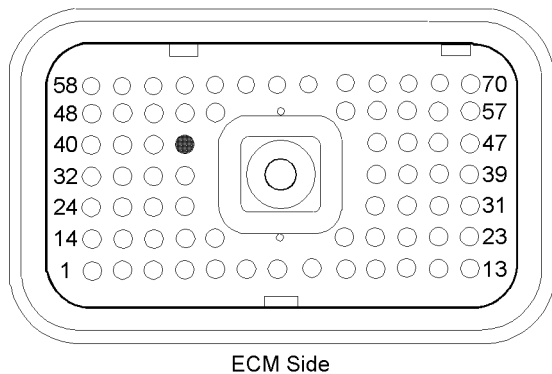


Illustration 28

g01304954

ECM pin location for starting aid
(43) Starting aid control

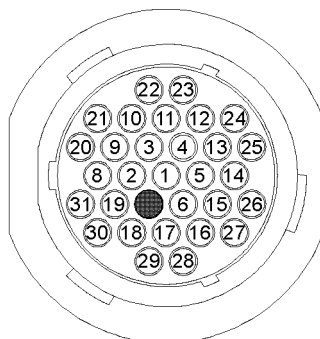


Illustration 29

g01306109

Pin locations for the starting aid on the 31 pin Machine Interface Connector (MIC).
(7) Starting aid control

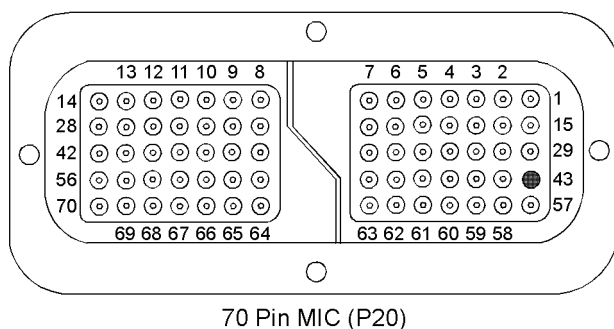


Illustration 30

g01305205

Pin locations for the starting aid on the 70 pin Machine Interface Connector (MIC).
(43) Starting aid control

Test Step 1. Inspect Electrical Connectors and Wiring

- A. Thoroughly inspect the J1/P1 ECM connector and J20/P20 MIC. Inspect the terminal connections on the starting aid relay. Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.
- B. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the starting aid. Refer to Illustration 28 and 30.
- C. Check the ECM connector (Allen head screw) for the correct torque of 6.0 N·m (55 lb in).
- D. Check the harness and wiring for abrasion and for pinch points from the sensors to the ECM.

Expected Result:

All connectors, pins and sockets should be completely coupled and/or inserted and the harness and wiring should be free of corrosion, abrasion or pinch points.

Results:

- OK – There are no faults in the wiring and the connectors. Proceed to Test Step 2.
- Not OK – There is a fault in the wiring and the connectors.

Repair: Perform the following repair:

Repair the connectors or wiring and/or replace the connectors or wiring. Ensure that all of the seals are properly in place and ensure that the connectors are completely coupled.

Verify that the repair eliminates the fault.

STOP.

Test Step 2. Check the Power Circuit of the Starting Aid Relay

- A. Turn the keyswitch to the ON position.
- B. Measure the voltage between the following contacts:
 - Terminal A and the battery - terminal
 - Terminal B and the battery - terminal

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24 Volt system.

Results:

- OK – The voltage is within limits. Proceed to Test Step 3.
- Not OK – The voltage is below limits between terminal A and the battery - terminal. There is a fault in the harness between the battery and the starting aid relay.

Repair: Check the 30 amp fuse. Repair the harness or replace the harness.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

- Not OK – The voltage is below limits between terminal B and the battery - terminal. There is a fault in the harness between the starting aid relay and the starting aid.

Repair: Repair the harness or replace the harness.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

Test Step 3. Check the Control Circuit of the Starting Aid Relay

- A. Turn the keyswitch to the ON position.
- B. Measure the voltage between the following points:
- Terminal C and the battery - terminal
 - Terminal D and the battery + terminal

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24 Volt system.

Results:

- OK – The voltage is within limits. Proceed to Test Step 4.
- Not OK – The voltage is below limits between terminal C and the battery - terminal. There is a fault in the harness between the battery and the starting aid relay.

Repair: Check the 3 amp fuse. Repair the harness or replace the harness.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

- Not OK – The voltage is below limits between terminal D and the battery + terminal. There is a fault in the harness between the starting aid relay and the ECM. Proceed to Test Step 4.

Test Step 4. Check the Supply Voltage at the Coil for the Starting Aid Relay

- A. Turn the keyswitch to the ON position.
- B. Measure the voltage between terminal C and terminal D.
- C. Turn the keyswitch to the OFF position and then turn the keyswitch to the ON position.
- D. Check that the voltage is present with the keyswitch in the ON position.
- E. Check that there is no voltage with the keyswitch in the OFF position.

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24 Volt system.

Results:

- OK – The voltage is within limits. There is a fault in the starting aid relay.

Repair: Replace the starting aid relay.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

- Not OK – There is no voltage or the voltage is out of the acceptable range. Proceed to Test Step 5.

Test Step 5. Check the Output from the Power Relay for the Starting Aid

- A. Turn the keyswitch to the ON position. Refer to Illustration 26.
- B. Measure the voltage between the following contacts:
- (B)

- NEG battery

Expected Result:

The battery has the proper voltage.

Results:

- OK – Proceed to Test Step 6.
- Not OK – There is a fault in the wires between the relay and the starting aid.

Repair: Repair the wires or replace the wires. Verify that the repair has eliminated the fault.

STOP.

Test Step 6. Ground the Input to the Power Relay at the MIC

- Turn the keyswitch to the OFF position.
- On engines with a 31 pin MIC, disconnect P20 connector from the MIC and connect a 31 pin Breakout T.
- On engines with a 70 pin MIC, disconnect P20 connector from the MIC and connect a 70 pin Breakout T.
- Connect the electronic service tool to the diagnostic connector.
- Turn the keyswitch to the ON position.
- Use the override setting in the electronic service tool in order to engage the air inlet heater starting aid.
- On engines with a 31 pin MIC, measure the voltage between P20:7 starting aid control and socket 2 battery - on the Breakout T.
- On engines with a 70 pin MIC, measure the voltage between P20:43 starting aid control and socket 69 battery - on the Breakout T.

Expected Result:

The voltage is 0 volts when the starting aid is engaged.

Results:

- OK – Proceed to Test Step 7.
- Not OK – The fault is in the wires between the control relay for the starting aid and the MIC.

Repair: Repair the harness or replace the harness. Verify that the repair has eliminated the fault.

STOP.

Test Step 7. Ground the Input to the Power Relay at the ECM connector

- Turn the keyswitch to the OFF position.
- On engines with a 31 pin MIC, remove the 31 pin Breakout T and reconnect the P20 MIC.
- On engines with a 70 pin MIC, remove the 70 pin Breakout T and reconnect the P20 MIC.
- Disconnect the P1 ECM connector from the ECM and connect a 70 pin Breakout T.
- Connect the electronic service tool to the diagnostic connector.
- Turn the keyswitch to the ON position.
- Insert one end of a jumper wire into J1:43 on the Breakout T. Monitor the status screen on the electronic service tool. Slowly connect and disconnect the other end of the jumper wire to socket 69 battery - on the Breakout T.

Expected Result:

When the jumper wire is connected the status of the relay should be closed.

When the jumper wire is disconnected the status of the relay should be open.

Results:

- OK – Proceed to Test Step 8.
- Not OK – The fault is in the wire harness between the MIC and the ECM connector.

Repair: Repair the damaged wire or replace the wire. Verify that the fault has been eliminated.

STOP.

Test Step 8. Override the Starting Aid in order to Test the ECM

- Turn the keyswitch to the OFF position.
- Remove the 70 pin Breakout T.
- Connect the P1 ECM connector.
- Connect the electronic service tool to the diagnostic connector.
- Turn the keyswitch to the ON position.

- F. Use the electronic service tool to monitor the status screen.
- G. Use the override parameter for the starting aid to override the following systems:
 - Glow plug starting aid (1104C engine)
 - Air inlet heater starting aid (1106C engine)
- H. Verify that the starting aid is either “enabled” or “disabled”.
- I. Verify that the lamp for the starting aid is on.

Expected Result:

The starting aid is working properly.

Results:

- OK – The ECM is operating properly. STOP.
- Not OK – The ECM is not working correctly.

Repair: Temporarily connect a test ECM. Remove all jumpers and replace all connectors. The test ECM should be programmed with the correct software. All parameters should be set to the same values as the suspect ECM.

If the fault is eliminated with the test ECM, reconnect the suspect ECM. If the fault returns with the suspect ECM, replace the suspect ECM.

Verify that the repair has eliminated the fault.

STOP.

i02607127

Analog Throttle Position Sensor Circuit - Test

System Operation Description:

Use this procedure if another procedure has directed you here. Use this procedure if any of the following diagnostic codes are active:

- 91-02 Throttle Position Sensor erratic, intermittent, or incorrect
- 91-03 Throttle Position Sensor voltage above normal
- 91-04 Throttle Position Sensor voltage below normal
- 91-12 Accelerator pedal - power supply failure

- 774-02 Secondary Throttle Position Sensor erratic, intermittent, or incorrect
- 774-03 Secondary Throttle Position Sensor voltage above normal
- 774-04 Secondary Throttle Position Sensor voltage below normal
- 774-12 Secondary Throttle Position Sensor failure

The Throttle Position Sensor (TPS) is an analog sensor and this sensor is attached directly to the throttle assembly. Foot or hand operated versions of the throttle assembly are available. The throttle position sensor provides an output voltage to the Electronic Control Module (ECM). The sensor output voltage will vary with the position of the throttle from 0.5 Volts to 4.5 Volts.

The sensor receives +5 Volt power from the ECM. The sensor will produce a voltage that will alter between low idle and high idle. The voltage is changed into a throttle position within the range 0 to 100 percent by the ECM.

The output voltage from the sensor is displayed on the electronic service tool as a percentage:

- 0.5 Volts = 5 percent
- 4.5 Volts = 95 percent

The TPS senses the speed requirement from the throttle position. A second TPS may override the speed requirement from the first TPS. This override will be subject to an input from either the SAE J1939 (CAN) or from the Set Speed Control. The input status can be checked on the electronic service tool Status Display Screen.

The system will check the position of the idle validation switch in relation to the throttle position signal when the idle validation has been set for use. If the switch position and the signal from the TPS are valid, then the throttle will operate as normal.

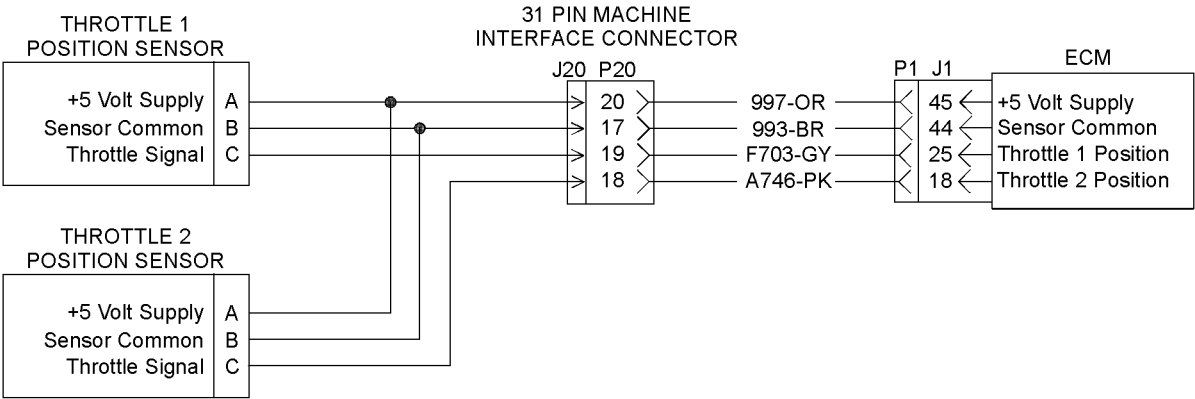


Illustration 31
Schematic of the analog throttle position sensor (31 Pin MIC)

g01305299

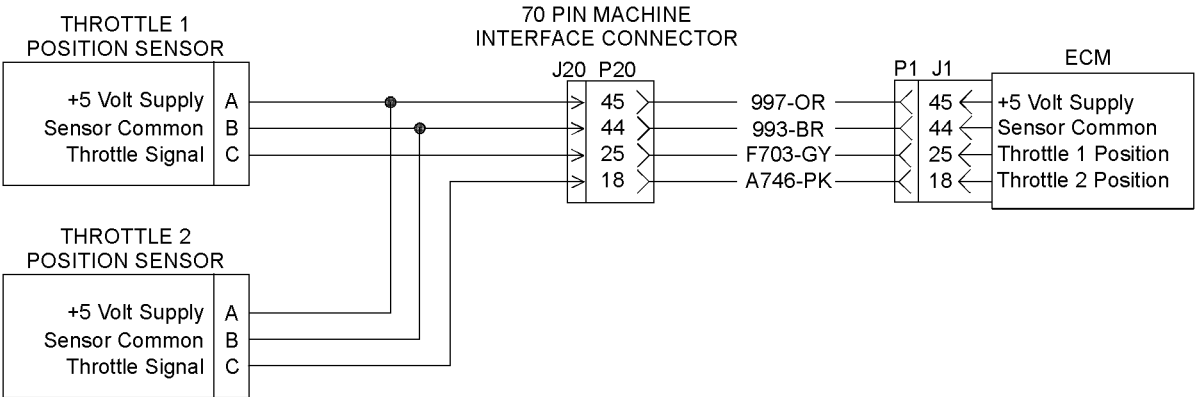
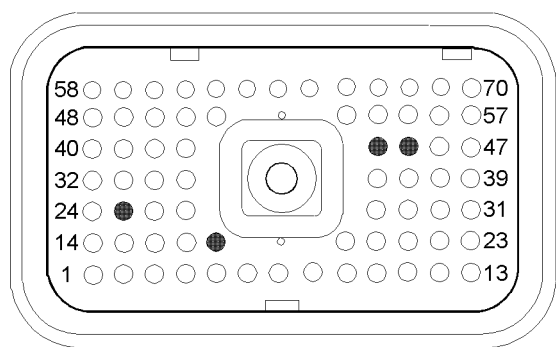


Illustration 32
Schematic of the analog throttle position sensor (70 Pin MIC)

g01305694



ECM Side

Illustration 33

g01305643

ECM pin locations

- (18) Throttle 2 Position
- (25) Throttle 1 Position
- (44) Sensor Common
- (45) +5 Volt Supply

Test Step 1. Inspect the Electrical Connectors and the Wiring

- A. Turn the keyswitch to the OFF position.
- B. Check the connectors and wiring for the following problems: damage, abrasion, corrosion, and incorrect attachment.
- C. Refer to Troubleshooting, "Electrical Connectors - Inspect".
- D. Perform a 45 N (10 lb) pull test on each of the wires in the harness that are associated with the throttle position sensor. Check the wire connectors at the ECM, at the MIC, and at the throttle assembly.
 - P1:18 Throttle No 2
 - P1:25 Throttle No 1
 - P1:44 Sensor common
 - P1:45 +5Volt DC sensor supply
- E. Check the ECM connector (Allen head screw) for the proper torque of 6.0 N·m (55 lb in).

Expected Result:

The connectors and wiring should be free of the following faults: damage, abrasion, corrosion, and incorrect attachment.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

Use the electronic service tool to clear all logged diagnostic codes and then verify that the repair has eliminated the fault.

STOP.

Test Step 2. Check for active Diagnostic Codes

- A. Turn the keyswitch to the ON position.
- B. Use the electronic service tool to clear any logged diagnostic codes.

Expected Result:

RESULT 1 The electronic service tool displays the following active diagnostic codes:

- 91-02 Throttle Position Sensor erratic, intermittent, or incorrect
- 774-02 Secondary Throttle Position Sensor erratic, intermittent, or incorrect

RESULT 2 The electronic service tool displays the following active diagnostic codes:

- 91-03 Throttle Position Sensor voltage above normal
- 91-04 Throttle Position Sensor voltage below normal
- 774-03 Secondary Throttle Position Sensor voltage above normal
- 774-04 Secondary Throttle Position Sensor voltage below normal

RESULT 3 No active diagnostic codes are displayed on the electronic service tool.

Results:

- Result 1

Repair: Refer to Troubleshooting, "Idle Validation Circuit Test".

STOP.

- Result 2 – Proceed to Test Step 3.
- Result 3 – Proceed to Test Step 4.

Test Step 3. Check the Throttle Position Sensor with the Electronic Service Tool

- A. Connect the electronic service tool to the diagnostic connector.
- B. Turn the keyswitch to the ON position. Do not start the engine.
- C. Monitor the raw throttle position reading on the electronic service tool.
- D. Depress the throttle and release the throttle.

Expected Result:

The raw output should increase when the throttle pedal is depressed.

The raw output should be between 15 percent and 27 percent at the low idle position. The output should be between 80 percent and 87 percent at the high idle position.

Results:

- OK – The throttle position sensor is operating correctly. Proceed to Test Step 5.
- Not OK – The ECM is not receiving the correct signal from the TPS. Proceed to Test Step 4.

Test Step 4. Check the Status of the Throttle Selection Switch with the Electronic Service Tool

- A. Turn the keyswitch to the ON position.
- B. Use the electronic service tool to check the status of the throttle selection switch (if equipped).

Expected Result:

If the throttle selection switch status is shown in the OFF position, then the throttle 1 has control of the engine speed.

If the throttle selection switch status is shown in the ON position then the throttle 2 has control of the engine speed.

The throttle can be overridden by use of the CAN B (SAE J1939) data link or the set speed control.

Results:

- OK – The throttle position switch is operating correctly.

Repair: There may be an intermittent fault. Refer to Troubleshooting, "Electrical Connectors - Inspect".

STOP.

- Not OK – The wrong throttle is selected. Change to the other throttle. There may be a fault with the input from the selector switch.

Repair: Check the connections between the throttle selection switch and P1:10 and P1:37. Refer to Troubleshooting, "Electrical Connectors – Inspect".

STOP.

Test Step 5. Check the Voltage at the Throttle Position Sensor

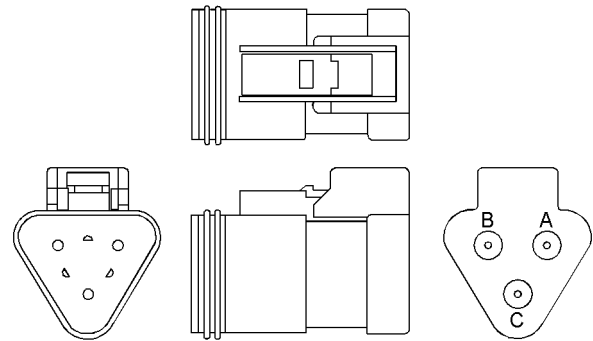


Illustration 34

g01311009

Connector for the throttle position sensor

- (A) +5 Volt Supply
- (B) Sensor Common
- (C) Throttle Position Signal

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the harness connector from the suspect TPS.
- C. Turn the keyswitch to the ON position.

Note: For the following tests, refer to Illustration 34.

- D. Use a multimeter to measure the voltages at the harness connector, between the following terminals:

- Terminal A to terminal B
- Terminal B to terminal C
- Terminal A to terminal C

Expected Result:

The voltages from the TPS should give the following readings:

- Terminal A to terminal B = 5.0 Volts DC
- Terminal B to terminal C = 10.25 Volts DC
- Terminal A to terminal C = 5.25 Volts DC

Results:

- OK – The voltages from the TPS are within limits. There is a fault in the sensor.

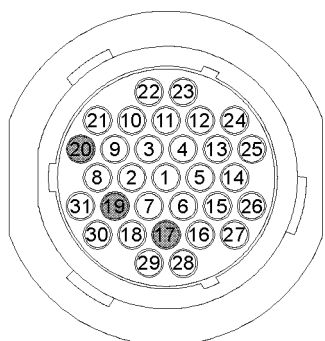
Repair: Replace the throttle position sensor, as follows:

1. Temporarily connect another TPS.
2. Use the electronic service tool to check if the diagnostic codes are still active.
3. If the replacement TPS eliminates the fault, reconnect the suspect sensor.
4. If the fault returns after connecting the suspect sensor, replace the TPS.
5. Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

- Not OK – One or more of the voltages from the TPS is out of limits. Proceed to Test Step 6.

Test Step 6. Check the Voltages for the Throttle at the Machine Interface Connector (MIC)



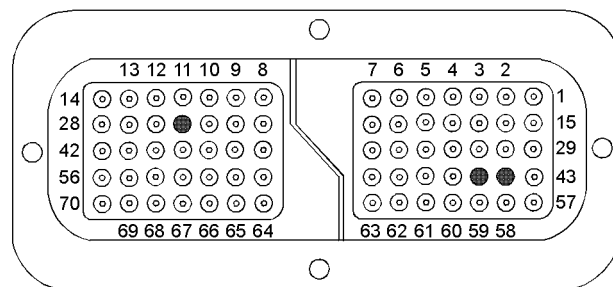
31 Pin MIC (P20)

Illustration 35

g01324968

Pin locations on the 31 pin MIC

- (17) Sensor Common
- (19) Throttle Signal
- (20) +5 Volt Supply



70 Pin MIC (P20)

Illustration 36

g01324988

Pin locations on the 70 pin MIC

- (25) Throttle Signal
- (44) Sensor Common
- (45) +5 Volt Supply

- Turn the keyswitch to the OFF position.
- Disconnect the P20 connector from the MIC.
- Turn the keyswitch to the ON position.
- On applications with a 31 pin MIC, measure the voltage between the following terminals:
 - Terminal P20:20 and terminal P20:17
 - Terminal P20:17 and terminal P20:19
 - Terminal P20:20 and terminal P20:19
- On applications with a 70 pin MIC, measure the voltage between the following terminals:
 - Terminal P20:45 and terminal P20:44
 - Terminal P20:44 and terminal P20:25
 - Terminal P20:45 and terminal P20:25

Expected Result:

The voltages from the TPS should give the following readings:

- +5 Volt Supply to Sensor Common = 5.0 Volts DC
- Sensor Common to Throttle Signal = approximately 10.25 Volts DC
- +5 Volt Supply to Throttle Signal = approximately 5.25 Volts DC

Results:

- OK – The voltages from the TPS are within limits. There is a fault with the harness between the sensor connector and the MIC.

Repair: There is a fault in the harness between the throttle position sensor and the P20 MIC.

1. Repair the harness or replace the harness.
2. Use the electronic service tool to clear any logged diagnostic codes and then verify that the repair has eliminated the fault.

STOP.

- Not OK

Repair: One or more of the voltages from the TPS is out of limits.

Proceed to Test Step 7.

Test Step 7. Check the Voltages from the Throttle at the ECM

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P1 connector from the ECM.
- C. Turn the keyswitch to the ON position.
- D. Use a multimeter to measure the voltage from the TPS between the following terminals on the harness connector:
 - Terminal P1:45 and terminal 1:44
 - Terminal P1:44 and terminal P1:25
 - Terminal P1:45 and terminal P1:25

Expected Result:

The voltages from the TPS should give the following readings:

- +5 Volt Supply to Sensor Common = 5.0 Volts DC
- Sensor Common to Throttle Signal = approximately 10.25 Volts DC
- +5 Volt Supply to Throttle Signal = approximately 5.25 Volts DC

Results:

- OK – The voltages from the TPS are within limits. There is a fault with the harness between the MIC and the ECM.

Repair: There is a fault in wires between the MIC and the ECM.

1. Repair the harness or replace the harness.

2. Use the electronic service tool to clear any logged diagnostic codes and then verify that the repair has eliminated the fault.

STOP.

- Not OK – One or more of the voltages from the TPS is out of limits at the ECM.

Repair: Check that the supply voltage at the ECM is correct. If the voltage is correct, the ECM is suspect. Perform the following procedure:

1. Temporarily connect a test ECM. Refer to Troubleshooting, "Replacing the ECM".
2. If the fault is eliminated by the test ECM, reconnect the suspect ECM and then verify that the fault returns.
3. If the fault returns with the suspect ECM, the suspect ECM is faulty. Replace the suspect ECM.
4. Use the electronic service tool to clear any logged diagnostic codes and then verify that the repair has eliminated the fault.

STOP.

- Not OK – If the ECM is not faulty, there is a fault in the harness or a connector between the sensor and the ECM.

Repair: Perform the following procedure:

1. Check all of the connectors between the ECM and the sensor.
2. Repair any damaged cables, or replace any damaged cables.
3. Use the electronic service tool to clear any logged diagnostic codes and then verify that the repair has eliminated the fault.

STOP.

i02613879

CAN Data Link Circuit - Test

System Operation Description:

Use this procedure if another procedure has directed you here. Also use this procedure if any of the following diagnostic codes are active:

- 342-02 Secondary Engine Speed Sensor erratic, intermittent, or incorrect

- 247-09 SAE J1939 Data Link abnormal update rate
- 1684-09 Fuel Injection Pump abnormal update rate
- 1684-14 Fuel Injection Pump special instruction

The engine is connected to two separate CAN buses. The two CAN buses are designated "CAN A" and "CAN B".

CAN A

The CAN A bus provides a data link between the Electronic Control Module (ECM) and the control module in the fuel injection pump.

The CAN A bus is a closed loop. A 120 ohm terminating resistor is installed inside the ECM and the control module in the fuel injection pump.

The CAN A bus is used to communicate the following information:

- Engine timing
- Fuel demand for the fuel injection pump
- Data for the fuel injection pump
- The status of the fuel injection pump

A fault on the CAN A bus will cause the following conditions to occur:

- The engine will shut down.
- The engine will not start.

Do not attempt to repair the harness that is between the ECM and the fuel injection pump. Always replace a harness that is damaged.

CAN B

The format of the CAN B bus is dependent on the application.

The CAN B bus can be part of the J1939 data link for the machine and the circuit will include 120 ohm terminating resistors.

The CAN B bus can be used as a non-terminated bus which only connects to a diagnostic connector.

The CAN B bus is used to communicate the following information:

- Engine data for the machine application
- Flashing information for the ECM

A fault on a terminated CAN B bus can cause the following conditions to occur:

- If equipped, Torque Speed Control 1 (TSC1) will default to limp home mode.
- If equipped, the display unit will not display any data.

A fault on a non-terminated CAN B bus can cause the following condition to occur:

- The ECM cannot be flashed.

If the fault that is being diagnosed is on the CAN A bus, perform Test Steps 1 to 4.

If the fault that is being diagnosed is on the CAN B bus, perform Test Steps 5 to 8.

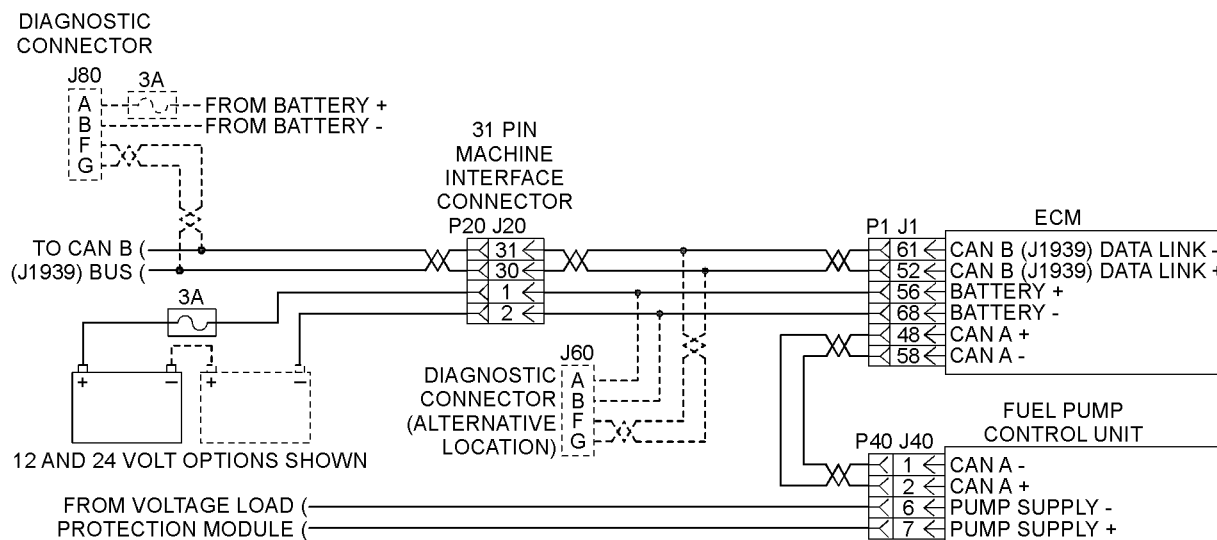


Illustration 37

g01320630

Schematic for the CAN data link (31 Pin MIC)

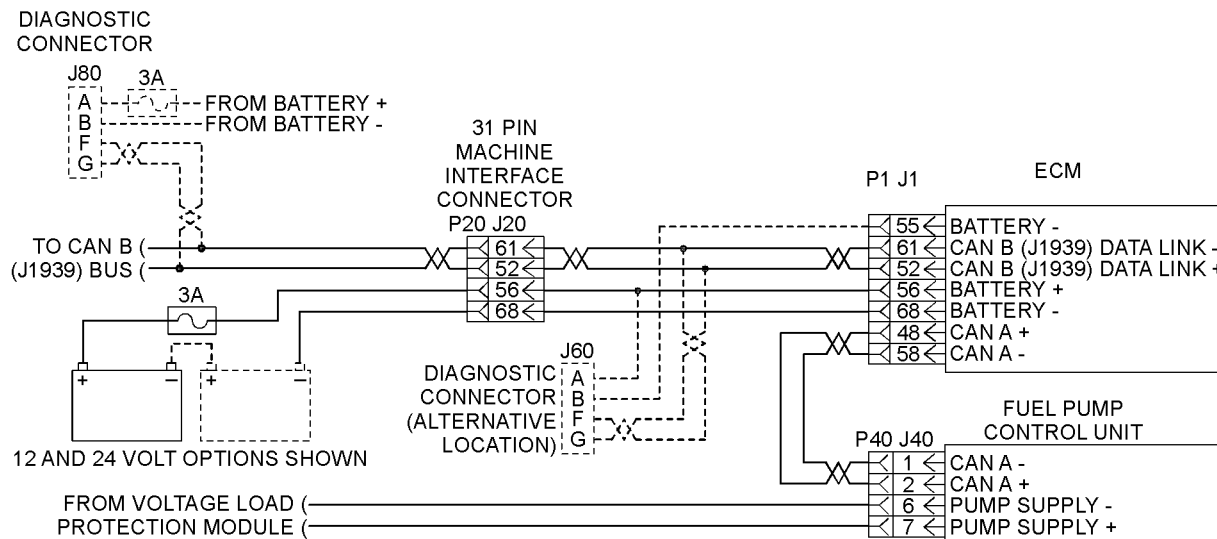
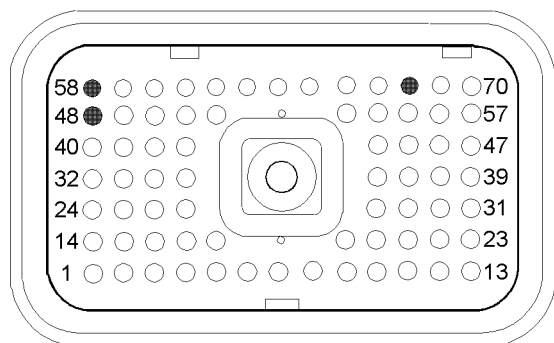


Illustration 38

g01324517

Schematic for the CAN data link (70 Pin MIC)

Test Step 1. Inspect The Electrical Connectors and the Wiring for the CAN A Bus



ECM Side

Illustration 39

g01308683

ECM pin locations

- (48) CAN A Data Link +
- (58) CAN A Data Link -
- (68) Battery -

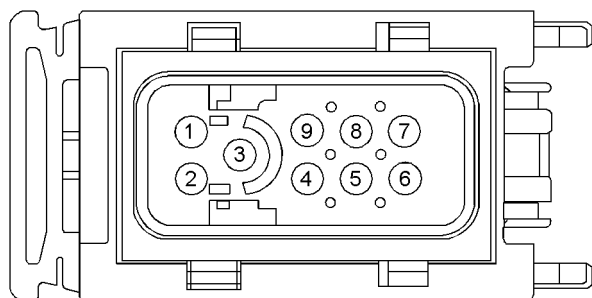


Illustration 40

g01320290

Pin locations on the fuel pump connector P40.

- (1) CAN A Data Link -
- (2) CAN A Data Link +
- (6) Pump supply -
- (7) Pump supply +

- A.** Turn the keyswitch to the OFF position.
- B.** Check the connectors and wiring for the following faults: damage, corrosion, abrasion, and incorrect attachment.
- C.** Pay close attention to the following areas:
 - ECM connector J1/P1
 - P1:48 CAN A Data Link +
 - P1:58 CAN A Data Link -
 - P40:2 CAN A Data Link +
 - P40:1 CAN A Data Link -

Refer to Troubleshooting, "Electrical Connectors - Inspect" for more information.

Expected Result:

The connectors and wiring should be free of the following faults: damage, corrosion, abrasion, and incorrect attachment.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair the CAN A data link circuit. Replace the cables or the connectors that are causing the fault. Ensure that all seals are properly placed and that all connectors are secured correctly.

Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

STOP.

Test Step 2. Check the CAN A Data Link Between the ECM and P40 Fuel Injection Pump Control Unit Connector for an Open Circuit

- A.** Disconnect P1 from the ECM.

Note: Do not disconnect P40 Fuel Injection Pump Connector.

- B.** Measure the resistance between terminal P1:48 and terminal P1:58.

Expected Result:

The readings should be between 100 ohms and 132 ohms.

Results:

- OK – Proceed to Test Step 3.
- Not OK

Repair: There is an open circuit in the harness between the P1 ECM connector and the control unit for the fuel injection pump. Repair the harness or replace the harness.

STOP.

Test Step 3. Check the CAN A Data Link Between the ECM and P40 Fuel Injection Pump Control Unit Connector for a Short Circuit

- A.** Disconnect P1 from the ECM.

Note: Do not disconnect P40 Fuel Injection Pump Connector.

B. Measure the resistance between terminal P1:58 and terminal P1:68.

C. Measure the resistance between terminal P1:48 and terminal P1:68.

Expected Result:

The readings should be more than 5,000 ohms.

Results:

- OK – Proceed to Test Step 4.
- Not OK

Repair: There is a short circuit in the harness between the P1 ECM connector and the control unit for the fuel injection pump. Repair the harness or replace the harness.

Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

STOP.

Test Step 4. Verify the Supply Voltage at the Fuel Injection Pump

- Turn the keyswitch to the OFF position.
- Disconnect the P40 connector from the fuel injection pump.
- Turn the keyswitch to the ON position.
- Measure the voltage between terminal J40:7 and terminal J40:6.
- Turn the keyswitch to the OFF position.
- Reconnect the P40 connector.

Expected Result:

The voltage for a 12 volt system should be constant. The voltage should be between 11.0 Volts DC and 13.5 Volts DC.

The voltage for a 24 volt system should be constant. The voltage should be between 22.0 Volts DC and 27.0 Volts DC.

Results:

- OK

Repair: Perform the following repairs:

1. Temporarily connect a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value as the suspect ECM.

2. If the fault is eliminated with the test ECM, reconnect the suspect ECM.
3. If the fault returns with the suspect ECM, then the suspect ECM is faulty. Replace the suspect ECM.

STOP.

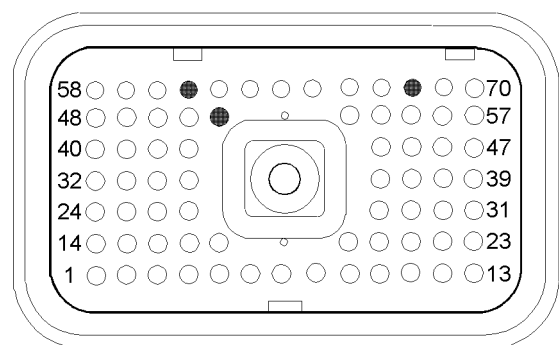
- Not OK – No voltage or the voltage is less than the permissible limit.

Repair: Refer to Troubleshooting, "Fuel Injection Pump Circuit - Test".

Verify that the repair has eliminated the fault.

STOP.

Test Step 5. Inspect the Electrical Connectors and the Wiring for the CAN B (J1939) Bus



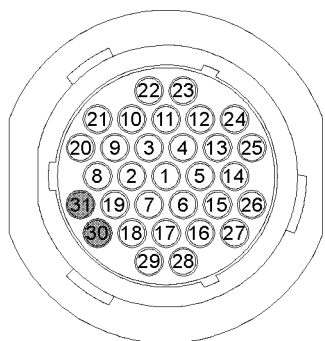
ECM Side

Illustration 41

g01321680

ECM pin locations

(52) CAN B (J1939) Data Link +
(61) CAN B (J1939) Data Link -

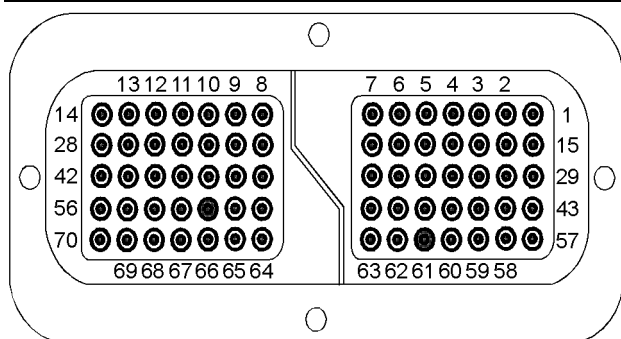


31 Pin MIC (P20)

Illustration 42

g01320244

Pin locations on the 31 pin MIC
(30) CAN B (J1939) Data Link +
(31) CAN B (J1939) Data Link -



70 Pin Machine Interface Connector (MIC)

Illustration 43

g01320247

Pin locations on the 70 pin MIC
(52) CAN B (J1939) Data Link +
(61) CAN B (J1939) Data Link -

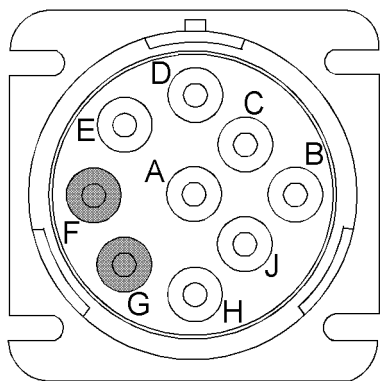


Illustration 44

g01320324

Pin locations on the diagnostic connector J60 or J80
(F) CAN B (J1939) Data Link -
(G) CAN B (J1939) Data Link +

- A. Turn the keyswitch to the OFF position.
- B. Check the connectors and wiring for the following faults: damage, corrosion, abrasion, and incorrect attachment.

C. Pay close attention to the following areas:

ECM connector J1/P1

- P1:52 CAN B (J1939) Data Link +
- P1:61 CAN B (J1939) Data Link -

31 pin Machine Interface Connector (MIC)

- J20:30 CAN B (J1939) Data Link +
- J20:31 CAN B (J1939) Data Link -

70 pin Machine Interface Connector (MIC)

- J20:52 CAN B (J1939) Data Link +
- J20:61 CAN B (J1939) Data Link -

J60 Diagnostic Connector

- J60:A Battery +
- J60:B Battery -
- J60:F CAN B (J1939) Data Link -
- J60:G CAN B (J1939) Data Link +

J80 Diagnostic Connector

- J80:A Battery +
- J80:B Battery -
- J80:F CAN B (J1939) Data Link -
- J80:G CAN B (J1939) Data Link +

Refer to Troubleshooting, "Electrical Connectors - Inspect" for more information.

Expected Result:

The connectors and wiring should be free of the following faults: damage, corrosion, abrasion, and incorrect attachment.

Results:

- OK – Proceed to Test Step 6.
- Not OK

Repair: Repair the CAN B (J1939) data link circuit. Replace the cables or the connectors that are causing the fault. Ensure that all seals are properly placed and that all connectors are secured correctly.

Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

STOP.

Test Step 6. Check the Battery Voltage at the Diagnostic Connector

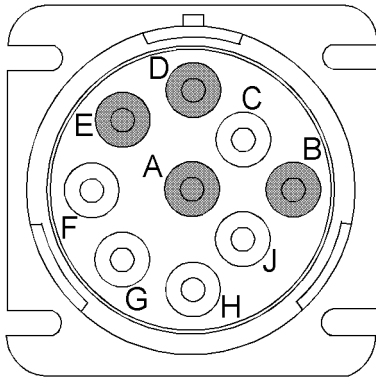


Illustration 45

g01324076

Pin locations on the J60 or J80 diagnostic connector

- (A) Battery +
- (B) Battery -
- (F) CAN B (J1939) Data Link +
- (G) CAN B (J1939) Data Link -

- A. Turn the keyswitch to the ON position.
- B. Use a multimeter in order to measure the voltage between the pin A Battery + and pin B Battery - on the diagnostic connector.

Refer to Illustration 45.

Expected Result:

The voltage is between 22.0 Volts DC and 27.0 Volts DC for a 24 volt system and between 11.0 Volts DC and 13.5 Volts DC for a 12 volt system.

Results:

- OK – On engines that connect to a machine CAN bus, proceed to Test Step 7.
- OK – On engines that do not connect to a machine CAN bus, proceed to Test Step 9.
- Not OK – The diagnostic connector is not receiving the correct voltage.

Repair: Inspect the wiring and fuses to the connector. Repair the wiring or batteries and/or replace the wiring or batteries, as required. If the diagnostic connector is part of the machine wiring harness, send the machine to the OEM dealer for repair.

Verify that the repair eliminates the fault.

STOP.

Test Step 7. Check for an Open Circuit on a CAN B (J1939) Data Link that is Connected to a CAN Bus on the Application

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P1 connector from the ECM.
- C. On applications that have a J60 diagnostic connector, measure the resistance between the following pins:
 - P1:52 and P1:61
 - J60:F and J60:G
- D. On applications that have a J80 diagnostic connector, measure the resistance between the following pins:
 - P1:52 and P1:61
 - P20:30 and P20:31 (31 pin MIC)
 - P20:52 and P20:61 (70 pin MIC)
 - J80:F and J80:G

Expected Result:

The resistance measurements should be approximately 60 ohms.

Results:

- OK – Proceed to Test Step 9.
- Not OK – The resistance measurement is more than 60 ohms or less than 60 ohms. There is an open circuit or a short circuit in the CAN B (J1939) data link.

Repair: If a fault is found between connectors P1 and J60 or connectors P1 and J20, perform the following procedure:

1. Repair the damaged wire or replace the damaged wire.
2. Ensure that all the connector seals are correctly installed and that the connectors are correctly coupled.
3. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

If a fault is found between connectors P20 and J80, refer to the documentation for the application.

STOP.

Test Step 8. Check for an Open Circuit on a CAN B (J1939) Data Link that is Not Connected to a CAN Bus on the Application

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P1 connector from the ECM.
- C. On applications that have a J60 diagnostic connector, check for continuity between the following pins:

31 pin MIC

- P1:52 and J20:30
- P1:61 and J20:31
- P1:52 and J60:G
- P1:61 and J60:F

70 pin MIC

- P1:52 and J20:52
- P1:61 and J20:61
- P1:52 and J60:G
- P1:61 and J60:F

- D. On applications that have a J80 diagnostic connector, check for continuity between the following pins:

- P1:52 and J80:G
- P1:61 and J80:F

Expected Result:

There is continuity between the respective pins.

Results:

- OK – Proceed to Test Step 9.
- Not OK – There is an open circuit in the CAN B (J1939) data link.

Repair: If a fault is found between connectors P1 and J20 or between connectors P1 and J60, perform the following procedure:

1. Repair the damaged wire or replace the damaged wire.

2. Ensure that all the connector seals are correctly installed and that the connectors are correctly coupled.

3. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

If a fault is found between connectors P20 and J80, refer to the documentation for the application.

STOP.

Test Step 9. Check the ECM

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P1 connector from the ECM.
- C. Temporarily connect a test ECM. Refer to Troubleshooting, "Replacing the ECM".

Note: The test ECM must be programmed with the correct software. All parameters must be set to the same values as the suspect ECM.

- D. Use the electronic service tool to check for active diagnostic codes. If the fault has been eliminated, reconnect the suspect ECM.

Expected Result:

The test ECM eliminates the fault and the fault returns with the suspect ECM.

Results:

- OK – There is an internal fault in the suspect ECM.

Repair: Perform the following procedure:

1. Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".
2. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

STOP.

- Not OK – The test ECM does not eliminate the fault. Repeat the test procedure from Test Step 1 or 5.

i02613912

Data Link Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

Use this procedure if the electronic service tool will not communicate with the Electronic Control Module (ECM) through the data link.

If the electronic service tool will not power up, refer to Troubleshooting, "Electrical Power Supply Circuit - Test".

Use this test if "Error" or incorrect values are being displayed on the Generic Engine Monitor (GEM). An incorrect value may be "0" for engine speed.

The following background information is related to this procedure:

The data link is used by the ECM in order to communicate with the electronic service tool.

The ECM provides the following two connections for the Data Link from the ECM connector J1:

- J1:4 Data Link +
- J1:5 Data Link -

The electrical system can have a 31 pin machine interface connector or a 70 pin machine interface connector. The electrical system can also have a diagnostic connector in the engine harness (J60) or a diagnostic connector in the machine harness (J80). Refer to the schematic diagrams in order to identify the connectors that are used on your installation.

Communication

The electronic service tool may indicate the following error message:

- The version of the ECM is not recognized and the integrity of the changed parameters and displayed data is not guaranteed.

This message will indicate that the version of the software that is in the electronic service tool is not the same version of the software that is in the ECM. Contact the Perkins Technical Service Centre in order to confirm the correct version of the software.

Test Step 1. Inspect Electrical Connectors and Wiring

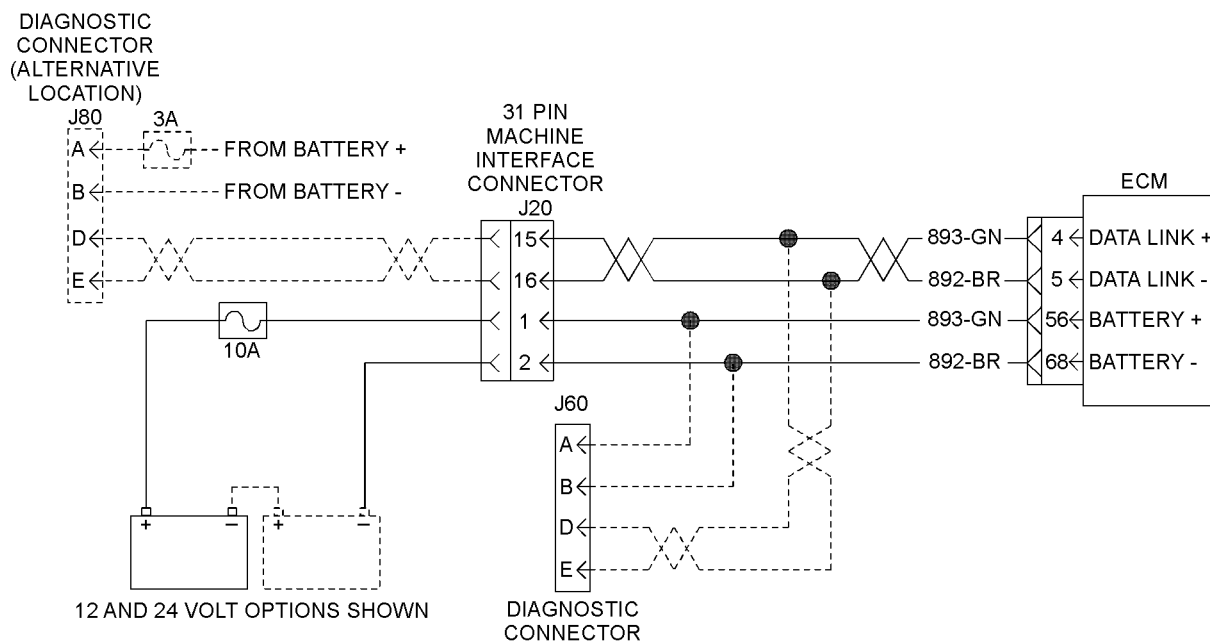


Illustration 46

g01309037

Schematic for the Data Link (31 Pin MIC)

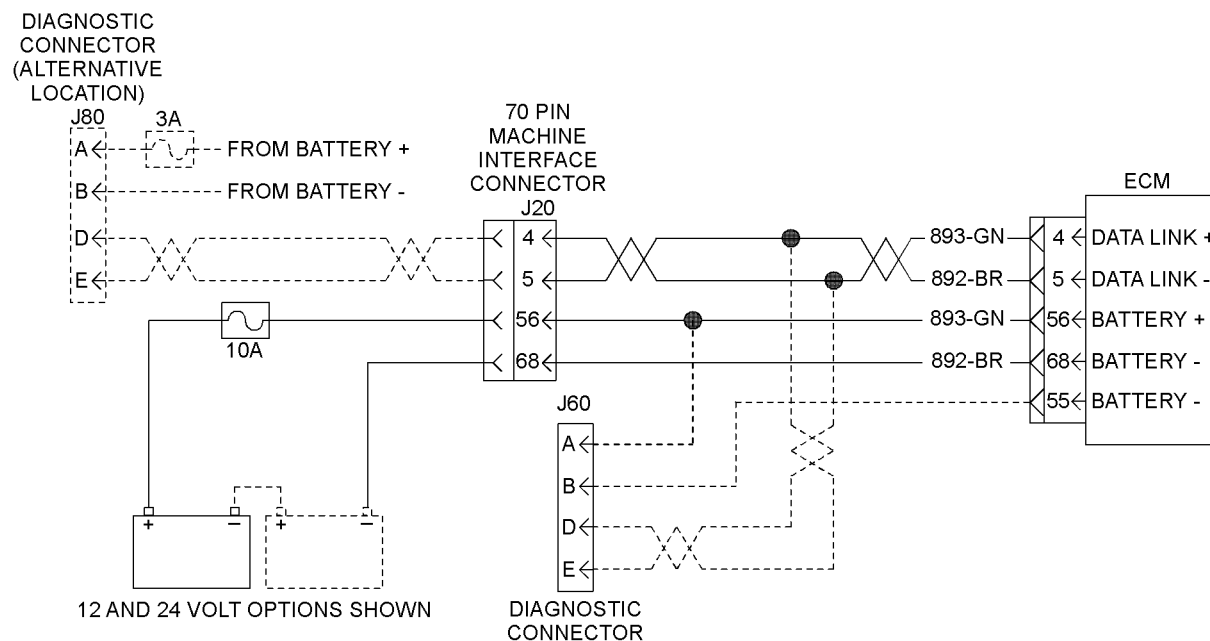
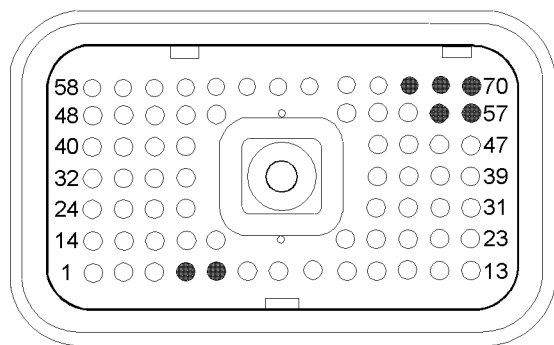


Illustration 47

g01324069

Schematic for the Data Link (70 Pin MIC)



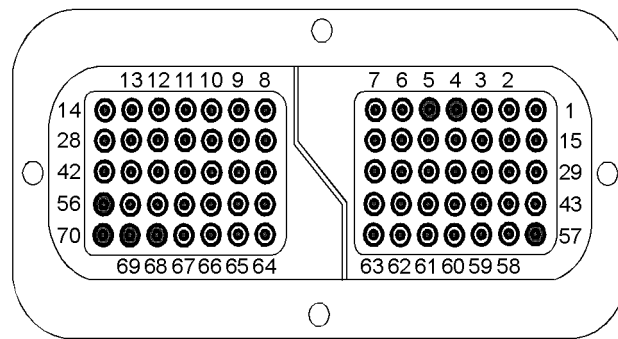
ECM Side

Illustration 48

g01309543

ECM pin locations

- (4) Data Link +
- (5) Data Link -
- (56) Battery +
- (57) Battery +
- (68) Battery -
- (69) Battery -
- (70) Keyswitch



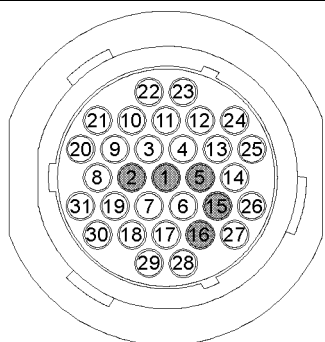
70 Pin Machine Interface Connector (MIC)

Illustration 50

g01310086

Pin locations on the 70 Pin MIC

- (4) Data Link +
- (5) Data Link -
- (56) Battery +
- (57) Battery +
- (68) Battery -
- (69) Battery -
- (70) Keyswitch



31 Pin MIC (P20)

Illustration 49

g01310096

Pin locations on the 31 Pin MIC

- (15) Data Link +
- (16) Data Link -
- (1) Battery +
- (2) Battery -
- (5) Keyswitch

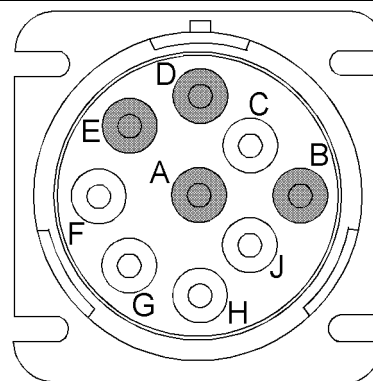


Illustration 51

g01324076

Pin locations on the J60 or J80 diagnostic connector

- (A) Battery +
- (B) Battery -
- (D) Data Link +
- (E) Data Link -

If the engine has a 31 pin MIC connector, refer to the following illustrations: Illustration 46, Illustration 48, Illustration 49, and Illustration 52.

If the engine has a 70 pin MIC connector, refer to the following illustrations: Illustration 47, Illustration 48, Illustration 50, and Illustration 52.

A. Thoroughly inspect the following electrical connectors.

- ECM connector J1/P1
- Data Link connectors J60 (if equipped), J80 (if equipped) and J20/P20
- If equipped, 31 pin Machine Interface Connector J20, pin 15 and pin 16.

- If equipped, 70 pin Machine Interface Connector J20, pin 4 and pin 5.

Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.

- B.** Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the Data Link.
- C.** Check the ECM connector (Allen head screw) for the proper torque of 6.0 N·m (55 lb in).
- D.** Check the harness and wiring for abrasion and pinch points from the connector to the ECM.

Expected Result:

All connectors, pins and sockets should be completely coupled and/or inserted. The harness and wiring should be free of corrosion, abrasion and/or pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK – There is a fault in a harness or a connector.

Repair: Perform the following repair:

Repair the connectors and/or the harness, or replace the connectors and/or the harness. Ensure that all of the seals are correctly installed and ensure that the connectors are completely coupled.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repair has eliminated the fault.

STOP.

Test Step 2. Determine the type of Fault on the Data Link

- A.** Connect the electronic service tool to the J60 diagnostic connector.
- B.** Start the engine.

Expected Result:

Result 1 The engine starts. The electronic service tool powers up and the electronic service tool communicates without error.

Result 2 The engine starts. The electronic service tool powers up but an error is displayed.

Result 3 The engine cranks but the engine will not start regardless of the condition of the electronic service tool.

Result 4 The engine will not crank regardless of the condition of the electronic service tool.

Result 5 The engine starts but the electronic service tool does not power up.

Results:

- Result 1 – There is not a problem with the data link at this time. If an intermittent condition exists, thoroughly inspect all wiring and connectors.

Repair: Perform the following diagnostic procedure:

Troubleshooting, "Electrical Connectors - Inspect"

STOP.

- Result 2 – The electronic service tool displays an error message. The ECM is receiving battery power. Proceed to Test Step 3.

- Result 3 –

Repair: Perform the following diagnostic procedure:

Troubleshooting, "Engine Will Not Crank"

STOP.

- Result 4 –

Repair: Perform the following diagnostic procedure:

Troubleshooting, "Engine Cranks But Will Not Start"

STOP.

- Result 5 – The electronic service tool does not power up or the communications adapter does not power up. Ensure that the ECM is receiving the correct battery power. Proceed to Test Step 4.

Test Step 3. Check the Battery Voltage at the ECM

- A.** Ensure that the electronic service tool is connected to the J60 diagnostic connector.
- B.** Disconnect ECM connector P1 from ECM connector J1.
- C.** Turn the keyswitch to the ON position.
- D.** Measure the voltage on P1 between sockets P1:56 (Battery +) and P1:68 (Battery -).

- E. On engines with a 70 pin MIC, measure the voltage on P1 between sockets P1:57 (Battery +) and P1:69 (Battery -).
- F. Measure the voltage on P1 between sockets P1:70 (keyswitch) and P1:68 (Battery -).

Refer to Illustration 48.

Expected Result:

The voltage is between 22.0 Volts DC and 27 Volts DC for a 24 Volt system and between 11.0 Volts DC and 13.5 Volts DC for a 12 Volt system when the keyswitch is in the ON position.

Results:

- OK – The ECM is currently receiving the correct voltage. Proceed to Test Step 4.
- Not OK – The ECM is not receiving the correct voltage.

Repair: Perform the following diagnostic procedure:

Troubleshooting, “Electrical Power Supply Circuit - Test”

STOP.

Test Step 4. Check the Battery Voltage at the Diagnostic Connector

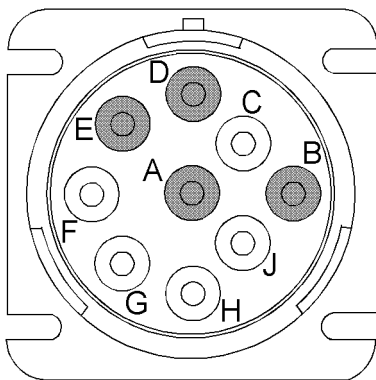


Illustration 52

g01324076

Pin locations on the J60 or J80 diagnostic connector

- (A) Battery +
(B) Battery -
(D) Data Link +
(E) Data Link -

- A. Turn the keyswitch to the ON position.
- B. Use a multimeter in order to measure the voltage between the pin A Battery + and pin B Battery - on the diagnostic connector.

Refer to Illustration 52.

Expected Result:

The voltage is between 22.0 Volts DC and 27.0 Volts DC for a 24 Volt system and between 11.0 Volts DC and 13.5 Volts DC for a 12 Volt system.

Results:

- OK – The diagnostic connector is currently receiving the correct voltage. Proceed to Test Step 7.
- Not OK – The diagnostic connector is not receiving the correct voltage.

Repair: Inspect the wiring and fuses to the connector. Repair the wiring or batteries and/or replace the wiring or batteries, as required. If the diagnostic connector is part of the machine wiring harness, send the machine to the OEM dealer for repair.

Verify that the repair eliminates the fault.

STOP.

Test Step 5. Check for an Open Circuit on the Data Link

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P1 connector from the ECM.
- C. On applications that have a J60 diagnostic connector, check for continuity between the following pins:

31 pin MIC

- P1:4 and J20:15
- P1:5 and J20:16
- P1:4 and J60:D
- P1:5 and J60:E

70 pin MIC

- P1:4 and J20:4
- P1:5 and J20:5
- P1:52 and J60:D
- P1:61 and J60:E

- D. On applications that have a J80 diagnostic connector, check for continuity between the following pins:
- P1:4 and J80:D

- P1:5 and J80:E

Expected Result:

There is continuity between the respective pins.

Results:

- OK – Proceed to Test Step 6.
- Not OK – There is an open circuit in the data link.

Repair: If a fault is found between connectors P1 and J20 or between connectors P1 and J60, perform the following procedure:

1. Repair the damaged wire or replace the damaged wire.
2. Ensure that all the connector seals are correctly installed and that the connectors are correctly coupled.
3. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

If a fault is found between connectors P20 and J80, refer to the documentation for the application.

STOP.

Test Step 6. Check the ECM

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P1 connector from the ECM.
- C. Temporarily connect a test ECM. Refer to Troubleshooting, "Replacing the ECM".

Note: The test ECM must be programmed with the correct software. All parameters must be set to the same values as the suspect ECM.

- D. Use the electronic service tool to check for active diagnostic codes. If the fault has been eliminated, reconnect the suspect ECM.

Expected Result:

The test ECM eliminates the fault and the fault returns with the suspect ECM.

Results:

- OK – There is an internal fault in the suspect ECM.

Repair: Perform the following procedure:

1. Replace the ECM. Refer to Troubleshooting, "Replacing the ECM".

2. Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

STOP.

- Not OK – The test ECM does not eliminate the fault. Proceed to Test Step 7.

Test Step 7. Connect the Electronic Service Tool directly to the ECM

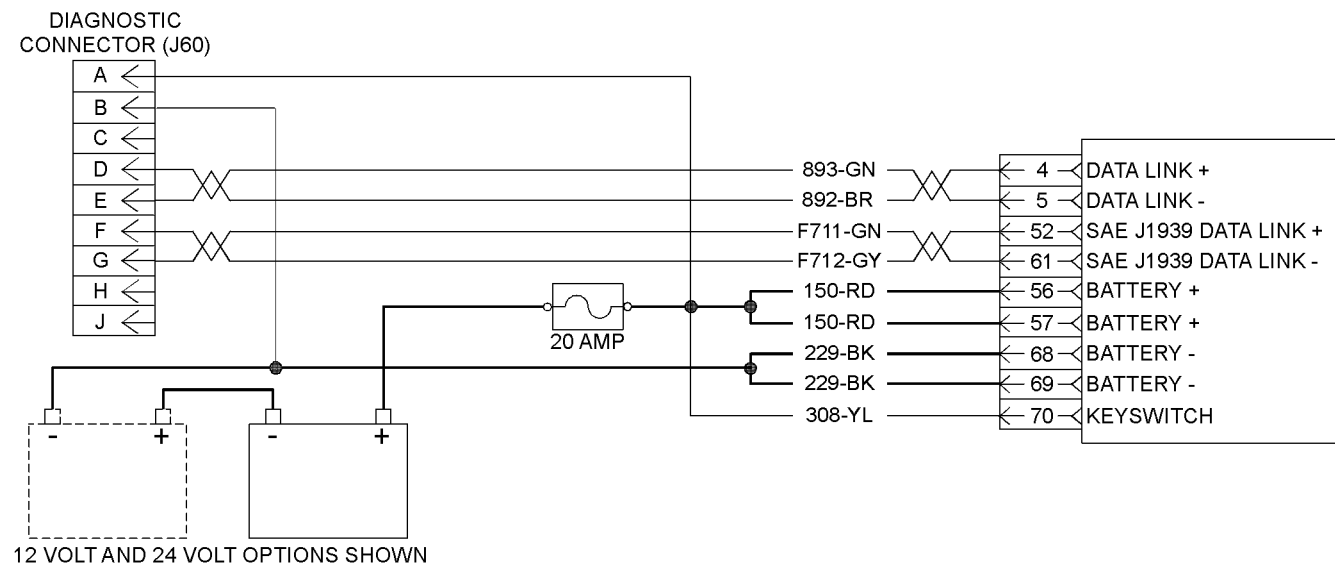


Illustration 53

g01310134

Typical bypass harness

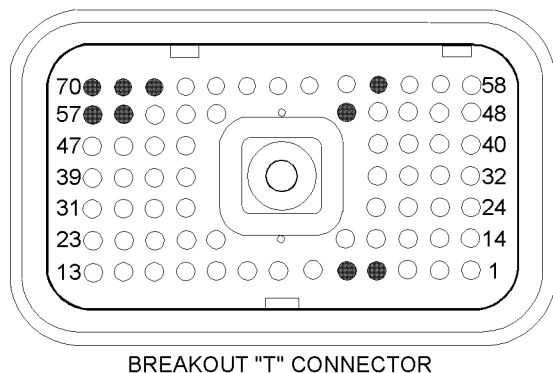


Illustration 54

g01310212

Pin locations on the breakout connector

- (4) Data Link +
- (5) Data Link -
- (52) SAE J1939 Data Link +
- (56) Battery +
- (57) Battery +
- (61) SAE J1939 Data Link -
- (68) Battery -
- (69) Battery -
- (70) Keyswitch



WARNING

Batteries give off flammable fumes which can explode.

To avoid injury or death, do not strike a match, cause a spark, or smoke in the vicinity of a battery.

NOTICE

Do not connect the bypass harness to the battery until the 20 Amp in-line fuse has been removed from the Battery + line. If the fuse is not removed before connection to the battery, a spark may result.

- A. Turn the keyswitch to the ON position.
- B. Disconnect engine harness connector J1/P1 from the ECM.
- C. Construct a bypass harness for the electronic service tool. Connect the bypass harness to ECM connector J1.

Refer to Illustration 53 for the bypass harness.

Note: This bypass directly connects the circuit for the keyswitch to the ECM. The ECM will remain powered until the connection to the unswitched battery + line is disconnected. Remove the 20 Amp fuse from the in-line fuse holder to power down the ECM. Do not connect the bypass to the battery posts without first removing the 20 Amp in-line fuse or do not remove the bypass from the battery posts without first removing the 20 Amp in-line fuse.

Expected Result:

The electronic service tool is operating correctly.

Results:

- OK

Repair: Perform the following repair:

There is a problem in the wiring. Inspect the wiring and fuses to the connector. Repair the wiring and/or batteries, or replace the wiring and/or batteries, as required.

Verify that the repair eliminates the fault.

STOP.

- Not OK – Verify that the 20 Amp fuse in the bypass harness of the electronic service tool is not open. A fuse that is open is a blown fuse. Proceed to Test Step 8.

Test Step 8. Change Electronic Service Tool Components

- If another electronic engine is available, connect the electronic service tool to the other engine. Ensure that the same cables are used.
- Turn the keyswitch to the ON position. Determine if the electronic service tool operates correctly on the other engine.
- If another engine is not available in the shop, find a different set of electronic service tool cables. Ensure that the set of electronic service tool cables is a complete set.
- Use the new set of cables and connect the electronic service tool to the Data Link connector.
- Turn the keyswitch to the ON position.
- If changing cables allows the electronic service tool to operate properly, use the following procedure:
 - Replace the pieces from the old set of cables into the new set of cables that operate. Replace one cable at a time.
 - Apply power to the electronic service tool after each of the cables is replaced. Use this method to find the faulty piece.
- If changing cables does not allow the electronic service tool to operate properly, connect another electronic service tool.
- Turn the keyswitch to the ON position.

Expected Result:

Result 1 The original electronic service tool works on another engine.

Result 2 A different electronic service tool works on the original engine while the engine is being tested.

Results:

- Result 1 – Proceed to Test Step 9.
- Result 2

Repair: Send the faulty electronic service tool for repairs.

STOP.

Test Step 9. Connect an Electronic Service Tool and the ECM to another Battery

WARNING

Batteries give off flammable fumes which can explode.

To avoid injury or death, do not strike a match, cause a spark, or smoke in the vicinity of a battery.

NOTICE

Do not connect the bypass harness to the battery until the 20 Amp in-line fuse has been removed from the battery + line. If the fuse is not removed before connection to the battery, a spark may result.

- Connect the battery wires from the bypass harness of the electronic service tool to a different battery that is not on the engine.

Expected Result:

The electronic service tool is operating correctly.

Results:

- OK

Repair: Perform the following diagnostic procedure:

Troubleshooting, "Electrical Power Supply Circuit - Test"

STOP.

- Not OK

Repair: Perform the following repair:

1. Temporarily connect a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value as the suspect ECM.

2. Remove all jumpers and reconnect all connectors.

3. Recheck the system for active diagnostic codes.
4. Repeat the test step.
5. If the fault is eliminated with the test ECM, reconnect the suspect ECM.
6. If the fault returns with the suspect ECM, replace the suspect ECM.
7. Verify that the repair eliminates the fault.

STOP.

The pedal mounted throttle position sensor sends a pulse width modulated signal. The signal varies with the throttle position. The signal is expressed as a percentage.

i02617093

Digital Throttle Position Sensor Circuit - Test

S/N: RF11-Up

S/N: RH11-Up

S/N: VK11-Up

System Operation Description:

Use this procedure if another procedure has directed you here. Use this procedure if any of the following diagnostic codes are active:

- 41-03 8 Volt DC Supply voltage above normal
- 41-04 8 Volt DC Supply voltage below normal
- 91-08 Throttle Position Sensor abnormal frequency, pulse width, or period
- 774-08 Secondary Throttle Position Sensor abnormal frequency, pulse width, or period

The pedal mounted throttle position sensor provides a Pulse Width Modulated (PWM) throttle position signal to the Electronic Control Module (ECM). The pedal mounted throttle position sensor is attached directly to the throttle assembly. Foot or hand operated versions of the throttle assembly are available.

The pedal mounted throttle position sensor will produce a duty cycle of 10 to 22 percent at low idle and 75 to 90 percent when the accelerator pedal is fully depressed.

The pedal mounted throttle position sensor will produce a minimum duty cycle when the pedal is released. The pedal mounted throttle position sensor will produce a maximum duty cycle when the pedal is fully depressed.

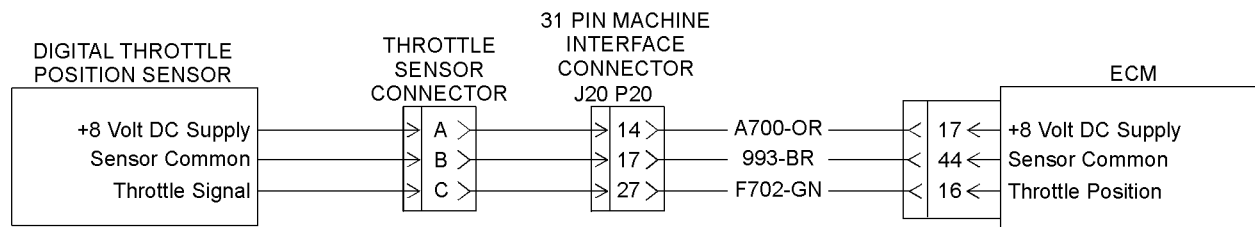


Illustration 55

g01310455

Schematic of the throttle position sensor (31 Pin MIC)

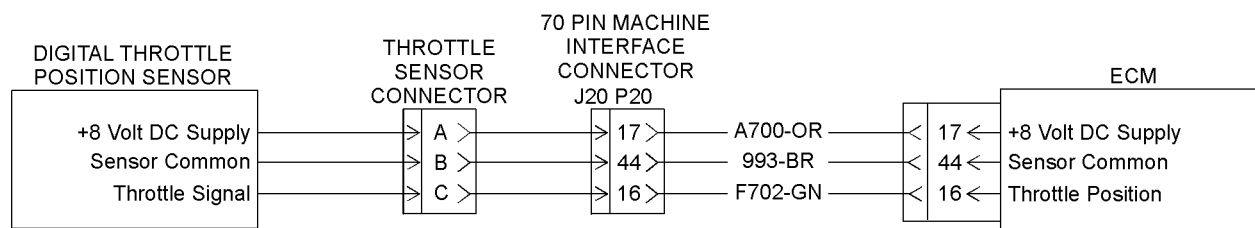


Illustration 56

g01310499

Schematic of the throttle position sensor (70 Pin MIC)

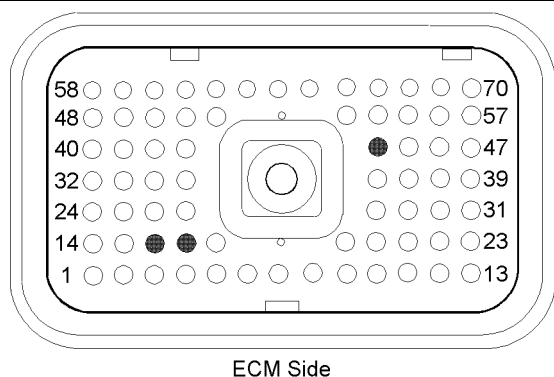


Illustration 57

g01310526

ECM pin locations

- (16) +8 Volt DC Supply
- (17) Sensor Common
- (44) Throttle Position

Test Step 1. Check for Connector Damage

- A. Turn the keyswitch to the OFF position.
- B. Check the connectors and wiring for the following faults: damage, abrasion, corrosion, and incorrect attachment.

C. Refer to Troubleshooting, "Electrical Connectors - Inspect".

D. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the pedal mounted throttle position sensor:

- P1:16
- P1:17
- P1:44

E. Check the ECM connector (Allen Head Screw) for the proper torque of 6.0 N·m (55 lb in).

Expected Result:

The connectors and wiring should be free of the following faults: damage, abrasion, corrosion, and incorrect attachment.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

Ensure that the repair has eliminated the fault.

STOP.

Test Step 2. Check for active Diagnostic Codes

- A. Turn the keyswitch to the ON position.
- B. Use the electronic service tool to check for diagnostic codes.

Expected Result:

RESULT 1 The electronic service tool displays the following active diagnostic codes:

- 91-08 Throttle Position Sensor abnormal frequency, pulse width, or period
- 774-08 Secondary Throttle Position Sensor abnormal frequency, pulse width, or period

RESULT 2 The electronic service tool displays the following active diagnostic codes:

- 41-03 8 Volt DC Supply voltage above normal
- 41-04 8 Volt DC Supply voltage below normal

RESULT 3 The electronic service tool displays no active diagnostic codes.

Results:

- Result 1 – Proceed to Test Step 3.
- Result 2 – Proceed to Test Step 5.
- Result 3 – Proceed to Test Step 3.

Test Step 3. Check the Throttle Position with the Electronic Service Tool

- A. Connect the electronic service tool to the J60 diagnostic connector.
- B. Turn the keyswitch to the ON position. Do not start the engine.
- C. Observe the throttle position reading on the electronic service tool.
- D. Depress the throttle and release the throttle.

Expected Result:

Calibrated Position

The output should be “0 percent” when the pedal is released. The output should increase to “100 percent” when the throttle pedal is fully depressed.

Raw Position

The output should be between “20 percent” and “27 percent” at the low idle position. The output should be between “80 percent” and “87 percent” at the high idle position.

Results:

- OK – The throttle position sensor is operating correctly. Proceed to Test Step 5.
- Not OK – The ECM is not receiving a correct signal from the sensor. There may be a problem in the harness. Proceed to Test Step 4.

Test Step 4. Check the Voltage at the Throttle Position Sensor.

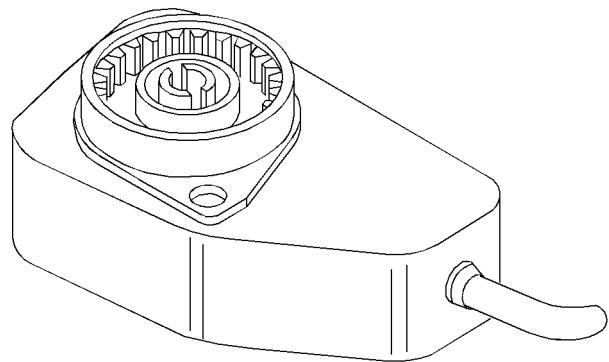


Illustration 58

g01310532

Typical example of the throttle position sensor

- A. Turn the keyswitch to the OFF position.
- B. Install a Breakout T with 3 terminals for this test procedure. Refer to Illustration 55 or illustration 56.
- C. Turn the keyswitch to the ON position.
- D. Measure the voltage between terminal A and terminal B.

Expected Result:

Supply voltage should be between 7.6 Volts DC and 8.4 Volts DC.

Results:

- OK – The supply voltage is reaching the sensor. Proceed to Test Step 5.
- Not OK – Proceed to Test Step 6.

Test Step 5. Disconnect the Throttle Position Sensor and Check for Active Diagnostic Codes

- A. Turn the keyswitch to the ON position. Use the electronic service tool to check for active diagnostic codes.
- B. Ensure that one of the following diagnostic codes are active:
 - 41-03 8 Volt DC Supply voltage above normal
 - 41-04 8 Volt DC Supply voltage below normal
- C. While the throttle position sensor is connected and disconnected, monitor the electronic service tool screen. Check and record active diagnostic codes.

Expected Result:

Diagnostic codes are active after disconnecting the throttle sensor.

Diagnostic codes are not active after disconnecting the throttle sensor.

Results:

- OK – Diagnostic codes are not active after disconnecting the throttle position sensor. Reconnect the throttle sensor and proceed to test step 7.
- Not OK – Diagnostic codes are active after disconnecting the throttle position sensor.

Repair: Temporarily install another throttle position sensor. Use the electronic service tool in order to check if the diagnostic codes are still active. Replace the throttle position sensor if both of the following conditions occur:

- The fault is corrected with the new throttle position sensor.
- The fault returns after the old throttle position sensor has been reconnected.

STOP.

Test Step 6. Check the Throttle Selection Status with the Electronic Service Tool

- A. Check the status of the throttle selection switch (if equipped). The throttle selection status can be observed on the status display screen of the electronic service tool.

Expected Result:

If the throttle selection switch status is shown in the OFF position, then the Throttle 1 has control of the engine speed.

If the throttle selection switch status is shown in the ON position then the Throttle 2 has control of the engine speed.

The throttle could be overridden by instructions via the SAE J1939 (CAN) or the set speed control.

Results:

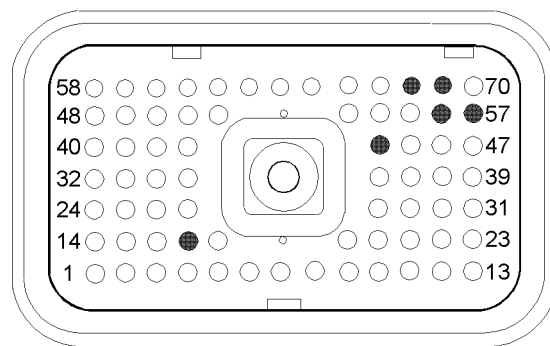
- OK – The throttle position sensor is operating correctly.

Repair: There may be an intermittent fault. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

STOP.

- Not OK – The wrong throttle is selected. Change to the other throttle. There may be a fault with the input from the selector switch. Proceed to Step 7.

Test Step 7. Disconnect the Supply Terminals of the Throttle Position Sensor at the ECM.



ECM Side

Illustration 59

g01310593

Connections for the ECM terminals

- (17) +8 Volt DC Supply
- (44) Sensor Common
- (56) Battery +
- (57) Battery + (if connected)
- (68) Battery -
- (69) Battery - (if connected)

- A. Turn the keyswitch to the OFF position.
- B. Remove P1:17 and P1:44 from the ECM connector P1.
- C. Turn the keyswitch to the ON position.
- D. Use the electronic service tool to check for active diagnostic codes.

Expected Result:

The ECM is not working correctly.

The cable between the ECM and the throttle position sensor is faulty.

The diagnostic codes are active.

Results:

- OK – Check for proper battery voltage.

Repair: Check the battery voltage from P1:56 and P1:57 to P1:68 and P1:69. Terminals P1:57 and P1:69 are not used in some installations.

The voltage should be between 11.0 to 13.5 Volts DC for a 12 Volt system. The voltage should be between 22.0 to 27.0 Volts DC for a 24 Volt system. If the battery voltage is correct and diagnostic codes are still active, then the ECM does not operate correctly.

1. Temporarily connect a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value as the suspect ECM.

2. If the fault is eliminated with the test ECM, reconnect the suspect ECM.
3. If the fault returns with the suspect ECM, then the suspect ECM is faulty.
4. Replace the suspect ECM.

The diagnostic codes are no longer active.

STOP.

- Not OK – There is a short circuit in the harness or connectors.

Repair: Perform the following procedure:

1. Connect the cables one at a time.
2. Connect P1:44.
3. Check if the diagnostic code reappears.
4. Connect P1:17.
5. Use the electronic service tool to check if the diagnostic code reappears.

6. Replace the faulty cable.

Verify that the repair has eliminated the fault.

STOP.

Test Step 8. Check the Position of Throttle Position Sensor

- A. Turn the keyswitch to the OFF position.
- B. Install a Breakout T with 3 terminals to the throttle position sensor.
- C. Turn the keyswitch to the ON position.
- D. Use a multimeter that has a setting for frequency or duty cycle to measure the PWM signal. Connect one probe to terminal C (throttle position sensor) and the other probe to terminal B sensor common of the Breakout T.
- E. Observe the position while the engine speed control is moved from the minimum to the maximum position.

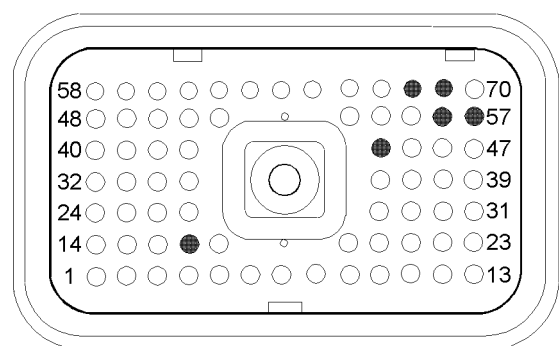
Expected Result:

The position should be between 10 and 22 percent in the low idle position.

The position should be between 75 and 90 percent in the high idle position.

Results:

- OK – The throttle position is working correctly. Proceed to Test Step 9.
- Not OK – The throttle position sensor is faulty. Proceed to Test Step 10.

Test Step 9. Check the Throttle Position Sensor at the ECM

ECM Side

Illustration 60

g01310607

Connections of the ECM terminals

(16) Throttle Position
(44) Sensor Common

- A. Turn the keyswitch to the OFF position.
- B. Remove terminal P1:16.

- C. Connect a multimeter that has a setting for frequency or duty cycle to terminal P1:16 and terminal P1:44.
- D. Turn the keyswitch to the ON position.
- E. Use the multimeter to measure the output signal of the throttle position sensor while the engine speed control is moved from the minimum position to the maximum position.
- F. Turn the keyswitch to the OFF position and connect terminal 16 to the P1 connector.

Expected Result:

The position should be between 10 and 22 percent in the low idle position.

The position should be between 75 and 90 percent in the high idle position.

Results:

- OK – The ECM terminals have the correct signal for the throttle position sensor.

Repair: Check for the proper supply voltage at the ECM. If the voltage is correct, then the ECM is suspect.

1. Temporarily connect a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value of the suspect ECM.

2. If the fault is eliminated with the test ECM, install the suspect ECM and verify that the fault returns.
3. If the fault returns replace the suspect ECM.

STOP.

- Not OK – There is a fault in the harness or the connectors between the sensor and the ECM. Check the terminals between the machine interface connector and the throttle position sensor. Repair the damaged cables or replace the damaged cables. Check that the repairs have eliminated the fault. STOP.

Test Step 10. Remove the Throttle Position Sensor from the Engine Speed Control Assembly

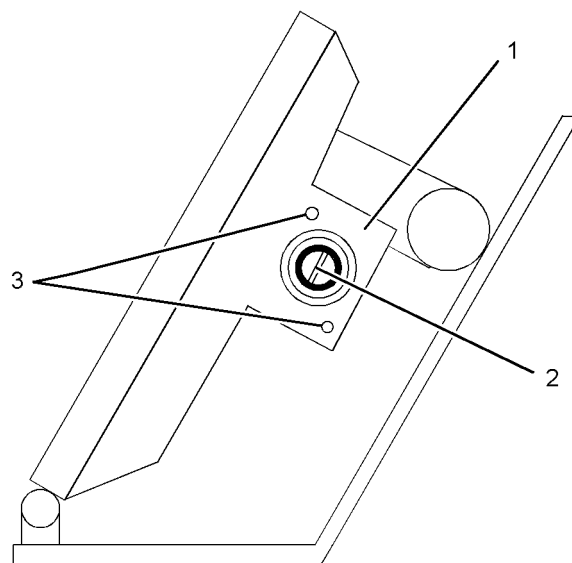


Illustration 61

g01185326

Throttle Pedal Assembly

- (1) Sensor mounting face
- (2) Sensor drive key
- (3) Mounting screw holes

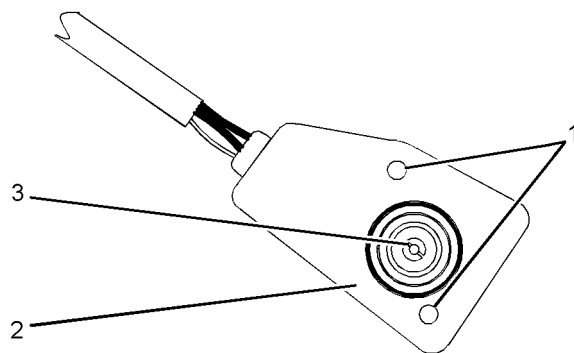


Illustration 62

g01185327

Throttle Sensor Assembly

- (1) Mounting screw holes
- (2) Sensor housing
- (3) Sensor drive slot

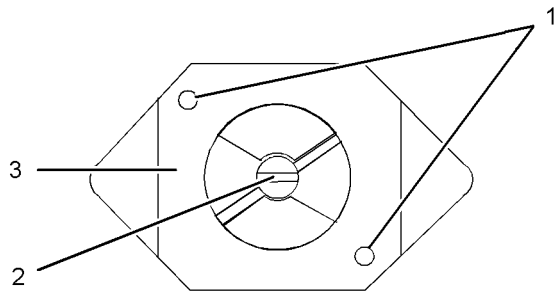


Illustration 63

g01185328

Throttle Sensor Assembly

- (1) Mounting screw holes
 (2) Sensor drive slot
 (3) Sensor mounting face

- A.** Turn the keyswitch to the OFF position.
- B.** Record the position of the sensor before removing the throttle position sensor.
- C.** Remove the throttle position sensor from the housing and inspect the cables for signs of wear.
- D.** Connect a multimeter to terminal C of the Breakout T.
- E.** Turn the keyswitch to the ON position.
- F.** Record the output signal of the throttle position sensor with the sensor slot in the released position.
- G.** Record the output signal of the throttle position sensor with the sensor slot in the advanced position.

Note: If the throttle reaches the minimum mechanical stop or the maximum mechanical stop, the throttle position sensor may not register a signal that is less than 10 percent or more than 90 percent.

Expected Result:

The throttle position sensor output is 10 percent or less.

The throttle position sensor output is 90 percent or more.

Results:

- OK

Repair: The operation of the throttle position sensor is correct. The fault is caused by the foot pedal or the lever assembly. Adjust the assembly or replace the assembly.

Verify that the repairs have eliminated the fault.

STOP.

- Not OK – The throttle position sensor is faulty.

Repair: Replace the throttle position sensor.

Verify that the repair has eliminated the fault.

STOP.

i02617839

Electrical Connectors - Inspect

System Operation Description:

Use this procedure in order to check the electrical connectors:

Use the following steps to help determine if a connector is the cause of a fault. If a fault is found in the electrical connector, repair the connector and verify that the fault has been corrected.

The following background information is related to this procedure:

Many of the operational procedures and the diagnostic code procedures in this troubleshooting guide will instruct you to check a specific electrical connector. The engine uses a variety of Deutsch and AMP connectors.

Intermittent electrical faults are often caused by poor connections. Always check for an active diagnostic code before breaking any connections. Also, always check for an active diagnostic code after the connector is reconnected in order to verify that the fault has been corrected.

Simply disconnecting the connectors and then reconnecting the connectors can temporarily solve a fault at times. If this occurs, check for the following conditions:

- Loose terminals
- Bent terminals
- Improperly crimped terminals
- Corrosion
- Incorrect routing of the harness

The original source of the fault must then be identified in order to ensure that the fault does not reoccur.

Follow this procedure to thoroughly inspect the connectors in order to determine if the connectors are the cause of the fault.

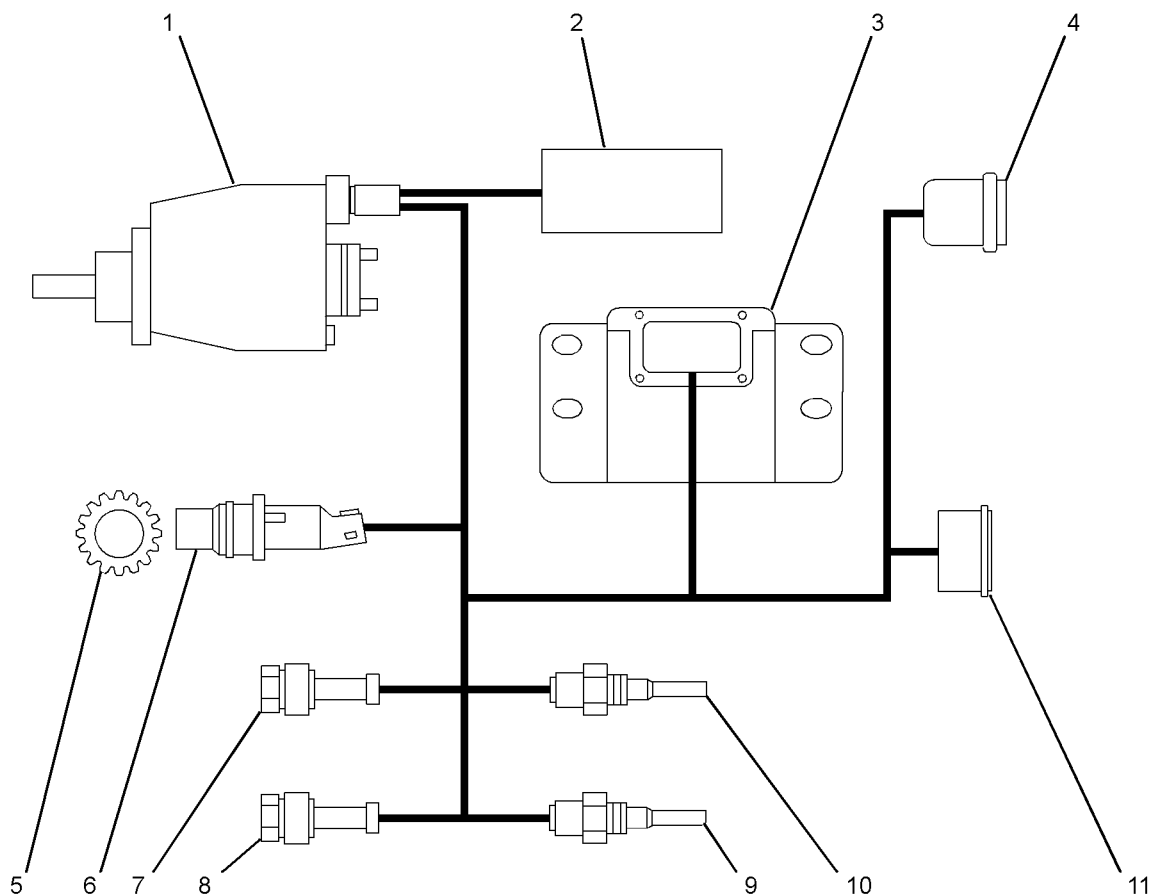


Illustration 64

g01320635

Schematic diagram of the fuel system

- | | | |
|---|-------------------------------------|--|
| (1) Fuel injection pump | (5) 36 -1 tooth crankshaft gear | (9) Intake manifold air temperature sensor |
| (2) Voltage Load Protection Module (VLPM) | (6) Speed/timing sensor | (10) Engine coolant temperature sensor |
| (3) Electronic Control Module (ECM) | (7) Intake manifold pressure sensor | (11) Machine interface connector |
| (4) Diagnostic connector | (8) Engine oil pressure sensor | |

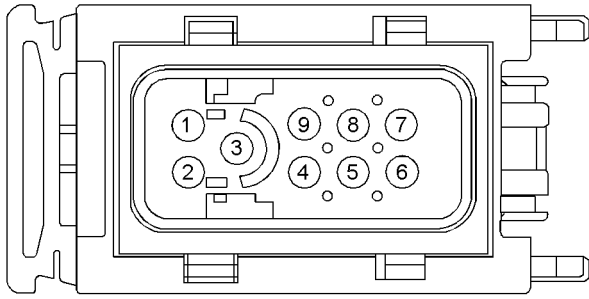
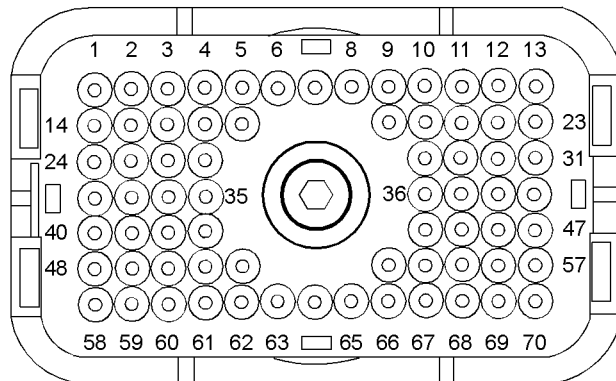


Illustration 65

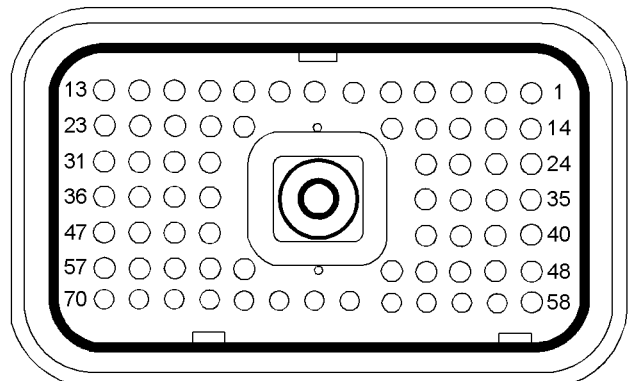
g01320641

"VP30" Fuel injection pump connector

- (1) CAN A -
- (2) CAN A +
- (3) Unused
- (4) Unused
- (5) Fuel shutoff
- (6) Pump supply -
- (7) Pump supply +
- (8) Engine position
- (9) Unused



WIRE HARNESS SIDE



ECM SIDE

Illustration 66

g01310928

Each end of the Machine SAE J1939 data link must be terminated with a 120 ohm resistor.



g01310958

31 pin Machine Interface Connector.



g01310959

70 pin Machine Interface Connector.

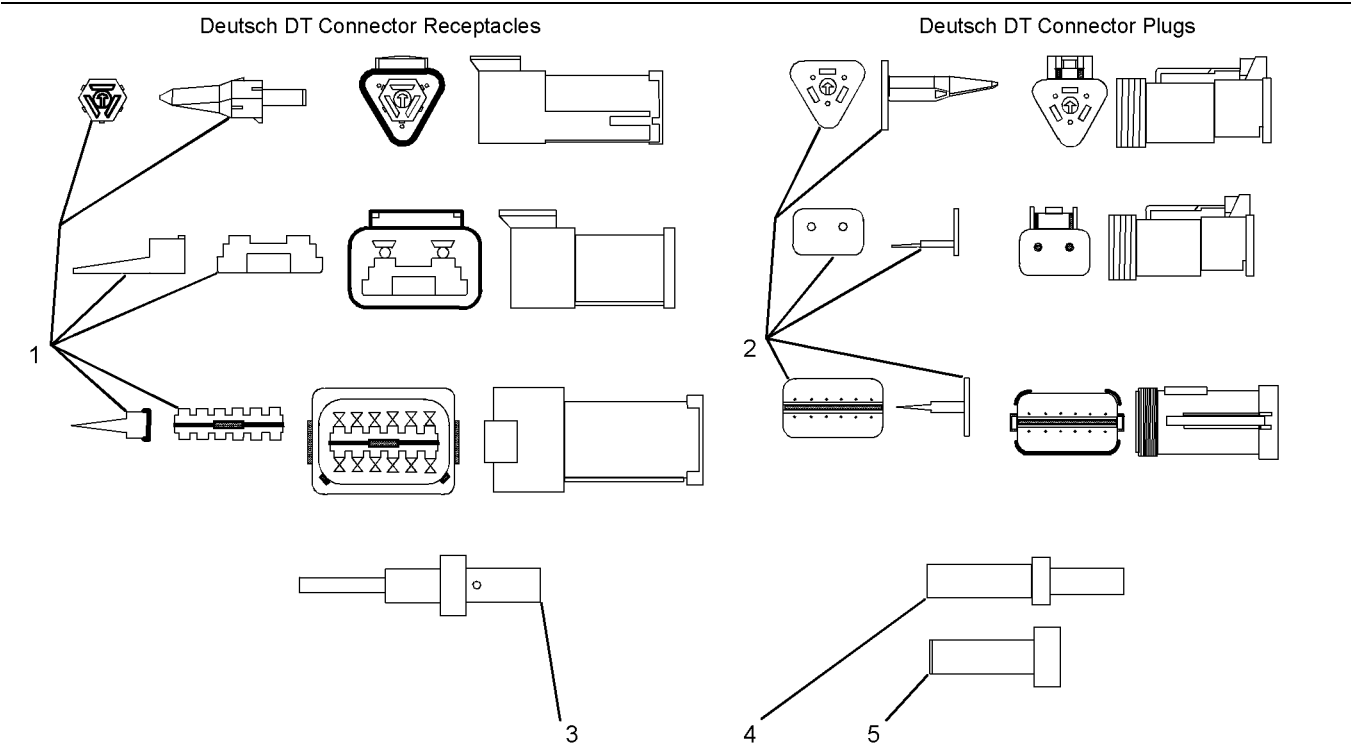


Illustration 69
Connector receptacles (Deutsch) and connector plugs (Deutsch)
(1) Receptacle wedge (2) Plug wedge (3) Terminal pin (4) Machined socket terminal (5) Sealing plug

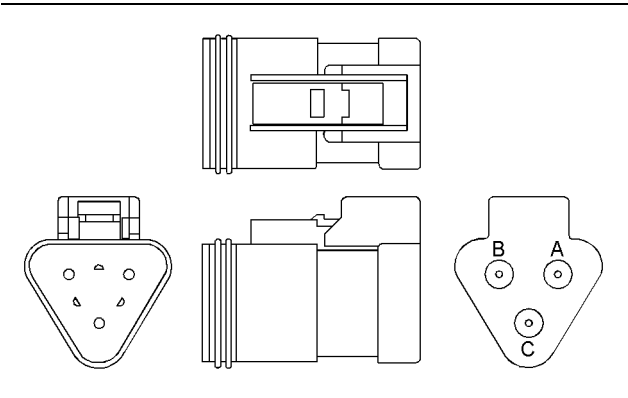


Illustration 70
3 pin Deutsch connector
(A) +5 Volt
(B) Sensor common
(C) Signal

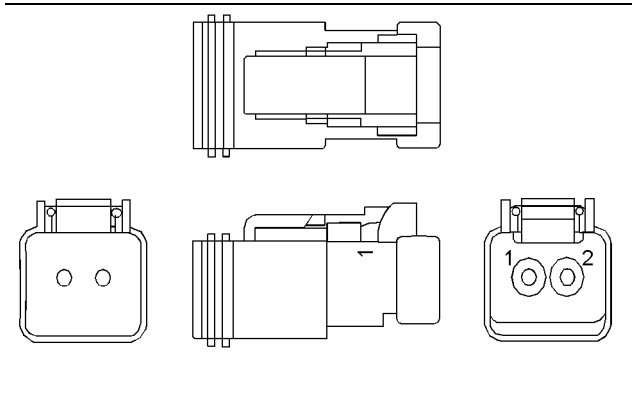


Illustration 71
2 pin Deutsch connector
(1) Signal
(2) Sensor common

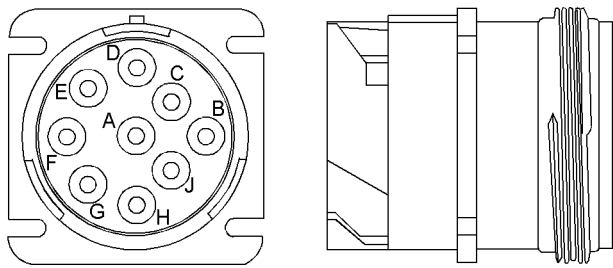


Illustration 72

g01311038

Deutsch data link connector

- (A) Battery +
- (B) Battery -
- (C) J1939 shield
- (D) Data Link +
- (E) Data Link -
- (F) J1939 -
- (G) J1939 +
- (H) Spare
- (J) Spare

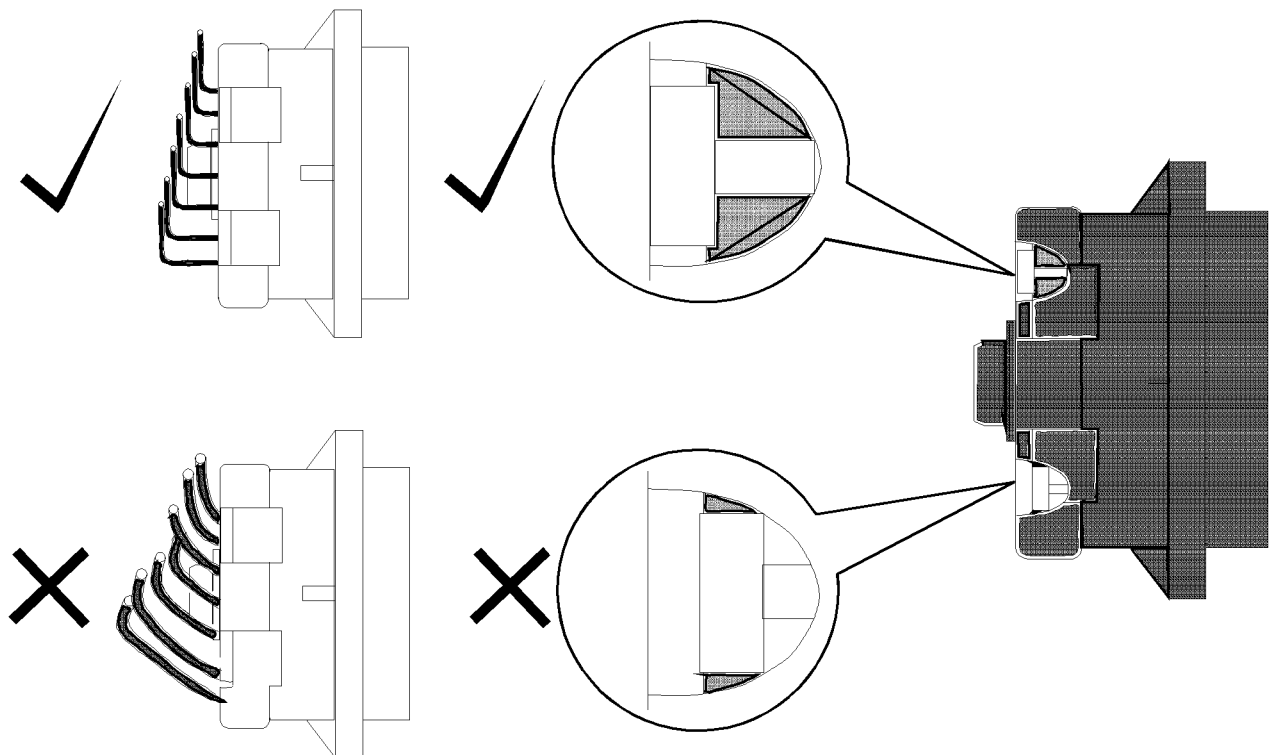


Illustration 73

g01311048

Routing of the harness and insertion of the plug

Test Step 1. Check Connectors for Moisture or Corrosion

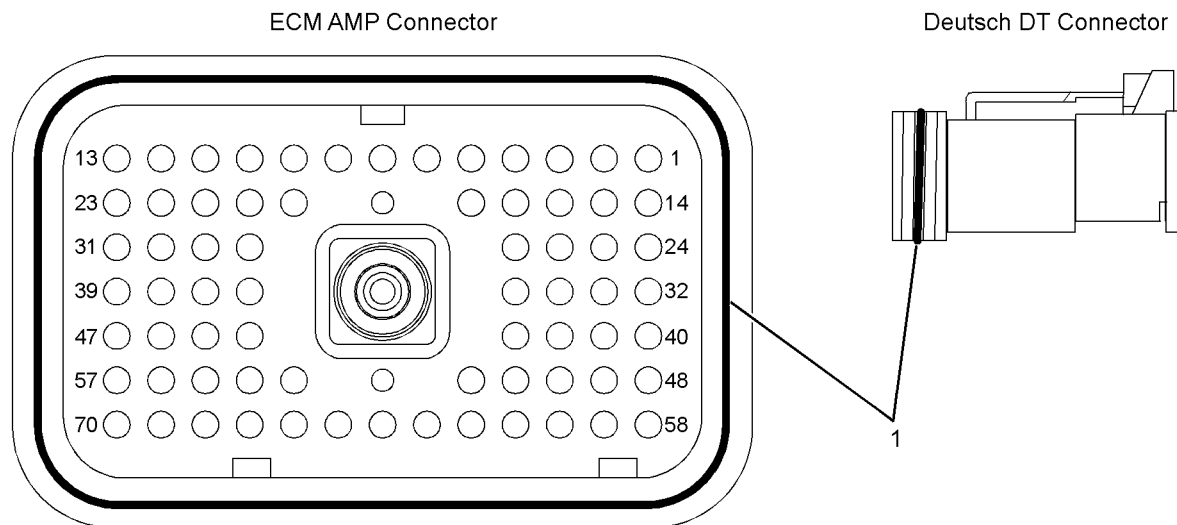


Illustration 74

g01311396

Connector seals

(1) Seal

- A.** Ensure that the connector seals and the white sealing plugs are in place. If any of the seals or plugs are missing, replace the seal or plug. If necessary, replace the connector.
- B.** Check all of the wiring harnesses in order to verify that the harness does not make a sharp bend out of a connector. This will deform the connector seal and this will create a path for the entrance of moisture.

Thoroughly inspect ECM connector J1/P1 and machine interface connector J20/P20 for evidence of moisture entry.

Note: It is normal to see some minor seal abrasion on the ECM connector seals. Minor seal abrasion will not allow the entry of moisture.

- C.** If moisture or corrosion is evident in the connector, the source of the moisture entry must be identified and the source of the moisture entry must be repaired. If the source of the moisture entry is not repaired, the fault will reoccur. Drying the connector will not fix the fault. Likely paths for the entrance of moisture are in the following list:

- Missing seals
- Incorrectly installed seals
- Nicks in exposed insulation
- Incorrectly mated connectors

Moisture can also travel from one connector through the inside of a wire to the ECM connector. If moisture is found in the ECM connector, thoroughly check all connectors and wires on the harness that connect to the ECM. The ECM is not the source of the moisture. Do not replace an ECM if moisture is found in either ECM connector.

Note: If corrosion is evident on the pins, sockets, or the connectors, use only denatured alcohol to remove the corrosion. Use a cotton swab or a soft brush to remove the corrosion. Do not use any cleaners that contain trichloro-ethylene because trichloro-ethylene will damage the connector.

Expected Result:

All of the connectors should be completely coupled and all of the seals should be completely inserted. The harness and the wiring should be free of corrosion, abrasion or pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair the connectors and/or wiring, or replace the connectors and/or wiring. Ensure that all of the seals are properly in place and ensure that the connectors are completely coupled.

Verify that the repair eliminates the fault by running the engine for several minutes and by checking again for moisture. If moisture reappears then the moisture may be contained within the insulation of the wiring. Replace any wires that may contain moisture inside the insulation. Verify that the repair eliminates the fault.

If the repair has not eliminated the fault proceed to Test Step 2.

Test Step 2. Check Wires for Nicks and/or Abrasions in the Insulation

- A.** Carefully inspect each wire for signs of abrasion, nicks, or cuts.

The following areas are locations that should be checked:

- Exposed insulation
- Points of rubbing wire against the engine
- Points of rubbing wire against a sharp point

- B.** Check all of the hold down clamps for the harness in order to verify that the harness is correctly clamped. Also check all of the hold down clamps for the harness in order to verify that the harness is not compressed by the clamp. Pull back the harness sleeves in order to check for a flattened portion of wire. The flattened portion of wire is caused by the clamp that holds the harness.

Expected Result:

The wires are free of abrasion, nicks, or cuts and the harness is correctly clamped.

Results:

- OK – Proceed to Test Step 3.
- Not OK – Repair the wires or replace the wires, as required. If the fault has not been eliminated, proceed to Test Step 3.

Test Step 3. Inspect the Connector Terminals.

- A.** Verify that the terminals are not damaged. Verify that the terminals are correctly aligned in the connector and verify that the terminals are correctly located in the connector.

Expected Result:

The terminals are correctly aligned and the terminals appear undamaged.

Results:

- OK – Proceed to Test Step 4.
- Not OK – Repair the terminals and/or wiring, or replace the terminals and/or wiring. If the repair has not eliminated the fault proceed to Test Step 4.

Test Step 4. Perform a Pull Test on each Wire Terminal Connection.

Note: This test checks whether the wire was correctly crimped in the terminal and whether the terminal was correctly inserted into the connector.

Note: Terminals should always be crimped onto the wires by use of a crimp tool. Do not solder the terminals.

- A.** Each terminal and each connector should withstand a 45 N (10 lb) pull test. Each wire should remain in the connector body.
- B.** The DT connectors use an orange wedge to lock the terminals in place.
- C.** Ensure that the orange wedge is not missing and that the orange wedge is installed correctly on the DT connectors.

Expected Result:

Each terminal and each connector can withstand 45 N (10 lb) of pull. Each wire remains in the connector body.

Results:

- OK – Proceed to Test Step 5.
- Not OK – Repair the wiring or replace the connector or the terminal.

Repair: Verify that the repair has eliminated the fault.

If the fault has not been eliminated, proceed to Test Step 5.

Test Step 5. Check Individual Pin Retention into the Socket

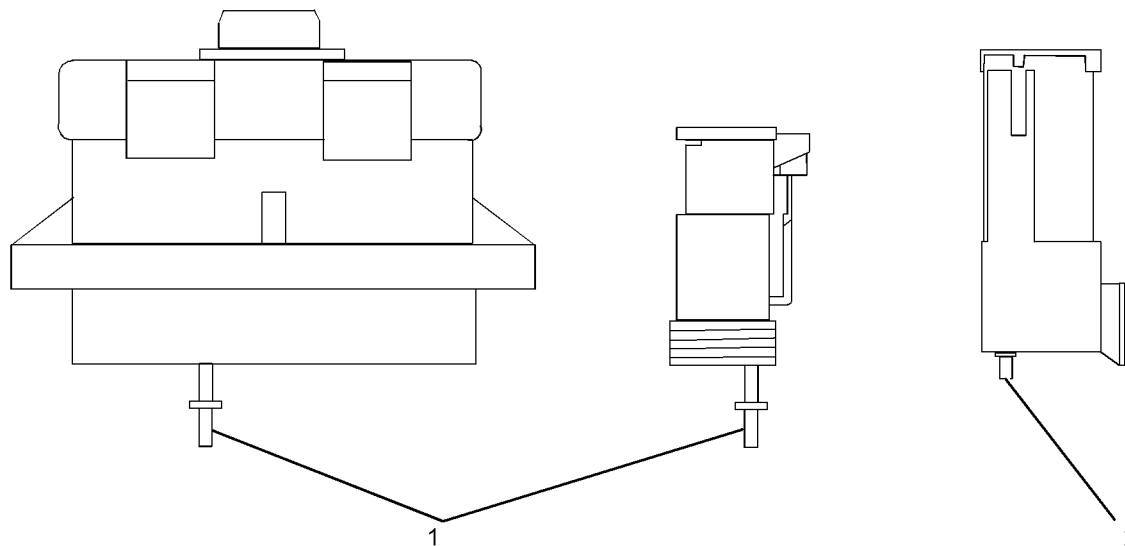


Illustration 75

g01311400

Pin retention of the connector

(1) Deutsch and AMP pin contact point.

(2) Deutsch and AMP socket contact point.

Note: This test is especially important for intermittent faults.

- A.** Use a new pin. Insert the pin into each socket one at a time in order to check for a good grip on the pin by the socket.
- B.** Use a new socket. Insert the socket over each pin one at a time in order to check for a good grip on the pin by the socket. The pins are located on the mating side of the connector.
- C.** The contact terminal should stay connected when the connector is held in the position shown in Illustration 75. The contact terminal is the pin or the socket.

Expected Result:

The pins and the sockets appear to be OK.

Results:

- OK – Proceed to Test Step 6.
- Not OK – Replace the terminal. STOP.

Test Step 6. Check the Locking of the DT Connector (Deutsch) and Check the Lock Ring of the HD Style Connector (Deutsch)

- A.** Ensure that the connector is properly latched and ensure that the two halves of the connector can not be pulled apart.

- B.** Verify that the latch tab of the connector is properly latched. Also verify that the latch tab of the connector returns to the fully latched position.

Expected Result:

Check that the connector will latch securely and check that the connector and the latching mechanism are not damaged.

Results:

- OK – Proceed to Test Step 7.
- Not OK – Repair the connector or replace the connector, as required.

Repair: Verify that the repair has eliminated the fault.

If the repair has not eliminated the fault, proceed to Test Step 7.

Test Step 7. Check the Allen Head Screw on the Connector for the Electronic Control Module (ECM)

Note: Do not exceed 6.0 N·m (55 lb in) of torque on the connector bolt of the ECM when the P1/J1 ECM connector is being installed on the ECM.

- A.** Ensure that the connector bolt is tightened to the correct torque.

Expected Result:

The ECM connector is secure and the connector bolt of the ECM is tightened to the correct torque.

Results:

- OK – Proceed to Test Step 8.
- Not OK – Secure the ECM connector.

Repair: Tighten the Allen head screw to the correct torque.

Verify that the fault has been eliminated.

If the fault has not been eliminated proceed to Test Step 8.

Test Step 8. Perform the “Wiggle Test” on the Electronic Service Tool (EST)

- A. Select the “Wiggle Test” from the diagnostic tests on the Perkins Electronic Service Tool (EST).
- B. Choose the appropriate group of parameters to monitor.
- C. Press the “Start” button. Wiggle the wiring harness in order to reproduce intermittent faults.

If an intermittent fault exists, the status will be highlighted and an audible beep will be heard.

Expected Result:

No intermittent faults were indicated during the “Wiggle Test”.

Results:

- OK – No intermittent faults were found. The harness and connectors appear to be OK. If this test was required as part of another procedure, return to that procedure and continue testing. If this test has resolved the fault, return the engine to service. STOP.
- Not OK – At least one intermittent fault was indicated.

Repair: Repair the harness or the connector.

Use the electronic service tool in order to clear all logged diagnostic codes and then verify that the repair eliminates the fault.

STOP.

i02618551

Electrical Power Supply Circuit - Test

System Operation Description:

Use this procedure under the following conditions:

This procedure tests whether the correct voltage is supplied by the wiring. Use this procedure if the diagnostic code is logged or active.

- 253-02 Personality Module erratic, intermittent, or incorrect

Note: This code can be generated by rapidly cycling the keyswitch. If this occurs, clear the logged diagnostic codes in order to prevent future confusion or an incorrect diagnosis.

The electronic service tool will indicate Low Battery Voltage if the ECM is not receiving the battery supply voltage.

Also use this procedure if another procedure has directed you here.

The following background information is related to this procedure:

The ECM receives electrical power (battery voltage) through the wiring within the engine harness. The ECM input at connector P1:70 (keyswitch) receives battery voltage from the keyswitch when the keyswitch is in the ON position or the START position. The ECM will power up when the ECM detects battery voltage at the keyswitch. The ECM will power down when battery voltage is removed from the keyswitch.

The cause of an intermittent power supply to the ECM can occur on either the positive side (battery +) or the negative side (battery -). Both sides are routed from the ECM to the battery. The connections for the battery + should be routed through a dedicated protection circuit.

The engine ECM requires the keyswitch to be in the ON position in order to maintain communications.

Temporarily bypassing the engine wiring may be an effective means of determining the root cause of intermittent problems such as intermittent shutdowns. If the symptoms disappear with the bypass wiring, the engine wiring is the cause of the fault. A means of bypassing engine wiring is explained in this test procedure.

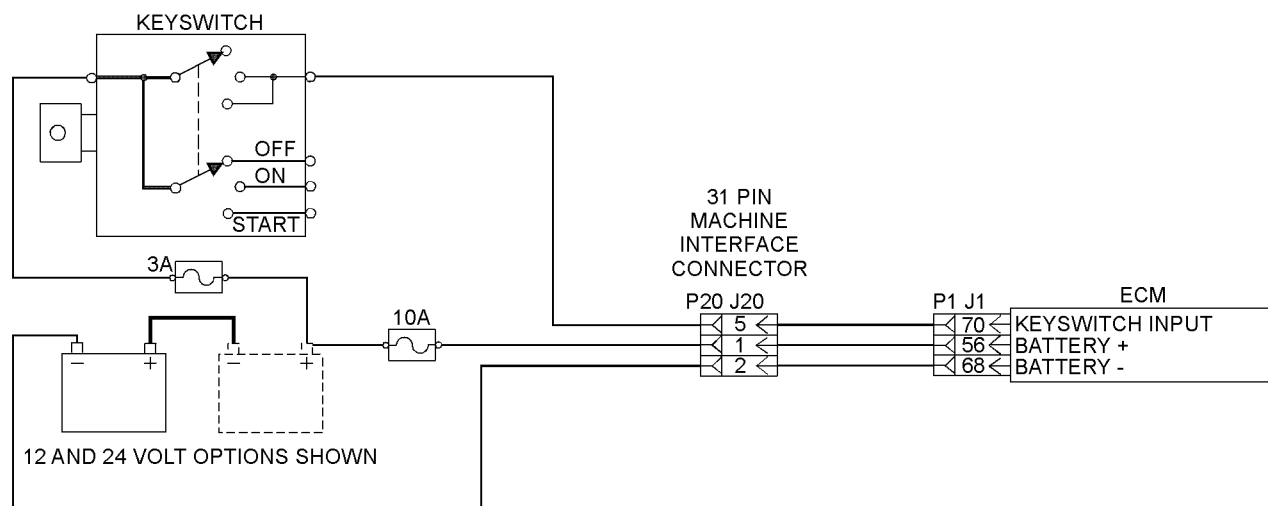


Illustration 76
Schematic of the power supply (31 pin MIC)

g01320724

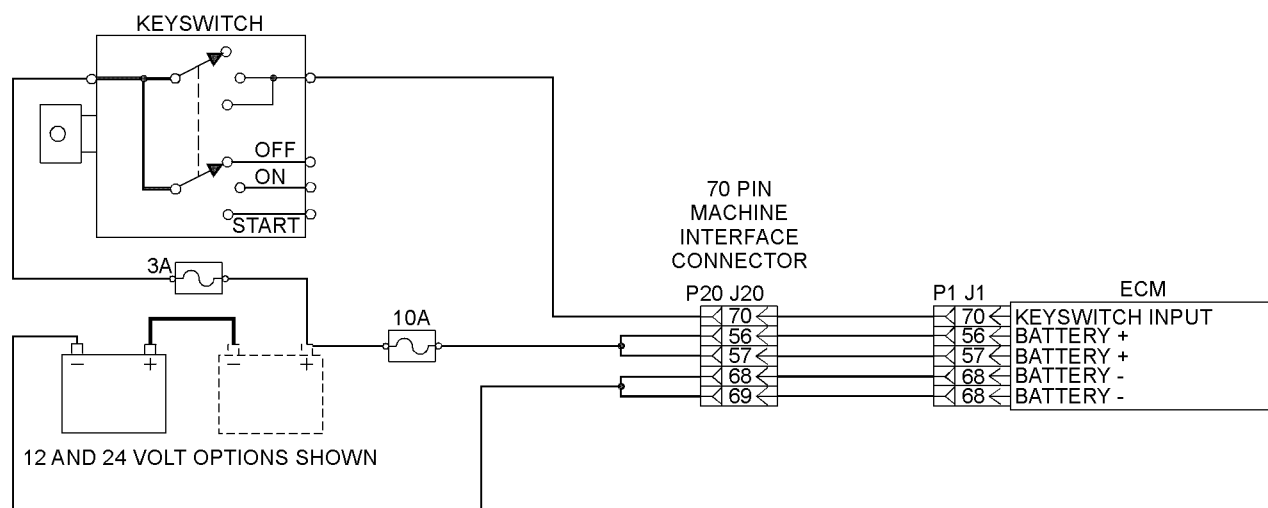


Illustration 77
Schematic of the power supply (70 pin MIC)

g01320767

⚠ WARNING

Batteries give off flammable fumes which can explode.

To avoid injury or death, do not strike a match, cause a spark, or smoke in the vicinity of a battery.

Test Step 1. Check The Batteries

- Measure no-load battery voltage at the battery posts.
- Load test the batteries.

Note: The batteries must pass the load test. The minimum voltage must be 11.5 Volts DC for a 12 Volt battery. If the battery voltage of a 12 Volt battery is below 12.4 Volts DC, the battery must be charged.

Expected Result:

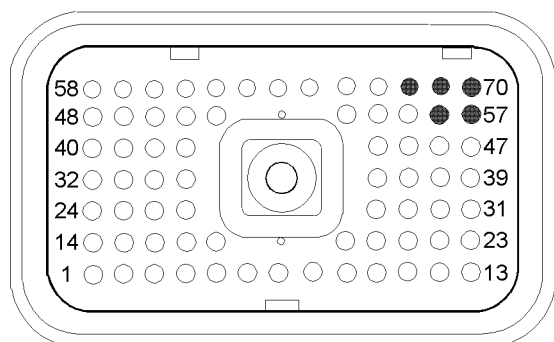
The batteries provide sufficient voltage.

Results:

- OK – Proceed to Test Step 2.
- Not OK – Recharge or replace the batteries. Verify that the repair eliminates the fault. STOP.

Test Step 2. Inspect Electrical Connectors And Wiring

Note: If the system has a 31 pin MIC, pins P1:57 and P1:69 are not used.



ECM Side

Illustration 78

g01311409

ECM pin locations

- (56) Battery +
- (57) Battery +
- (68) Battery -
- (69) Battery -
- (70) Keyswitch

- A.** Thoroughly inspect the harness connector J1/P1. Also inspect the connections for the battery and the connections to the keyswitch. Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.
- B.** Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector that are associated with the following connections:
 - P1:56 and P1:57 (Battery +)
 - P1:68 and P1:69 (Battery -)
 - P1:70 (Keyswitch)
- C.** Check the ECM connector (Allen head screw) for the correct torque of 6.0 N·m (55 lb in).
- D.** Check the harness and wiring for abrasions and for pinch points from the battery to the ECM. Also, check the harness and wiring for abrasions and for pinch points from the keyswitch to the ECM.

Expected Result:

All connectors, pins, and sockets should be completely coupled and/or inserted. The harness and wiring should be free of corrosion, abrasion, and/or pinch points.

Results:

- OK – Proceed to Test Step 3.

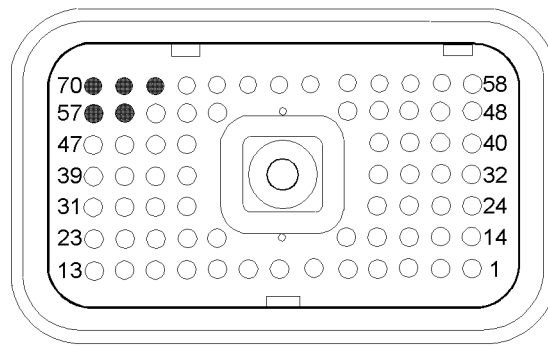
- Not OK – There is a fault in the connectors or wiring.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring. Ensure that all of the seals are correctly installed and ensure that the connectors are completely coupled.

STOP.

Test Step 3. Check the Battery Voltage at the ECM

Note: If the system has a 31 pin MIC, pins P1:57 and P1:69 are not used.



BREAKOUT "T" CONNECTOR

Illustration 79

g01311421

Test points for the Breakout T.

(56) Battery +
(57) Battery +(68) Battery -
(69) Battery -

(70) Keyswitch

- A. Disconnect engine harness connector P1 from ECM connector J1 and insert a 70 Pin Breakout T.
- B. Reconnect the harness.
- C. Turn the keyswitch to the ON position.
- D. Measure the voltage between P1:56 (Battery +) and P1:68 (Battery -).
- E. Measure the voltage between P1:57 (Battery +) and P1:69 (Battery -).

Refer to Illustration 79 for the ECM Breakout T-connector.

Note: Connections P1:57 and P1:69 are not used on certain installations.

Expected Result:

The measured voltage is between 11.0 Volts DC and 13.5 Volts DC for a 12 Volt system and between 22.0 Volts DC and 27.0 Volts DC for a 24 Volt system with no suspected intermittent faults.

Results:

- OK – Proceed to Test Step 4.
- Not OK

Repair: If the ECM is not receiving the correct voltage and an intermittent condition is suspected, refer to Troubleshooting, "Electrical Connectors - Inspect". Repair any damaged connectors or damaged wiring and/or replace any damaged connectors or damaged wiring. Verify that the repairs eliminate the fault and then proceed to Test Step 4.

If the voltage at the keyswitch is out of the nominal range, trace the wiring for the keyswitch from the ECM through the keyswitch circuit to the batteries. Identify the fault and repair the fault. Check the circuit protection for the circuit and for the wiring.

Verify that the repairs eliminate the fault.

STOP.

Test Step 4. Use the Bypass Harness for the Electronic Service Tool to Bypass the Machine Wiring

WARNING

Batteries give off flammable fumes which can explode.

To avoid injury or death, do not strike a match, cause a spark, or smoke in the vicinity of a battery.

NOTICE

Do not connect the bypass harness to the battery until the 20 Amp in-line fuse has been removed from the battery+ line. If the fuse is not removed before connection to the battery, a spark may result.

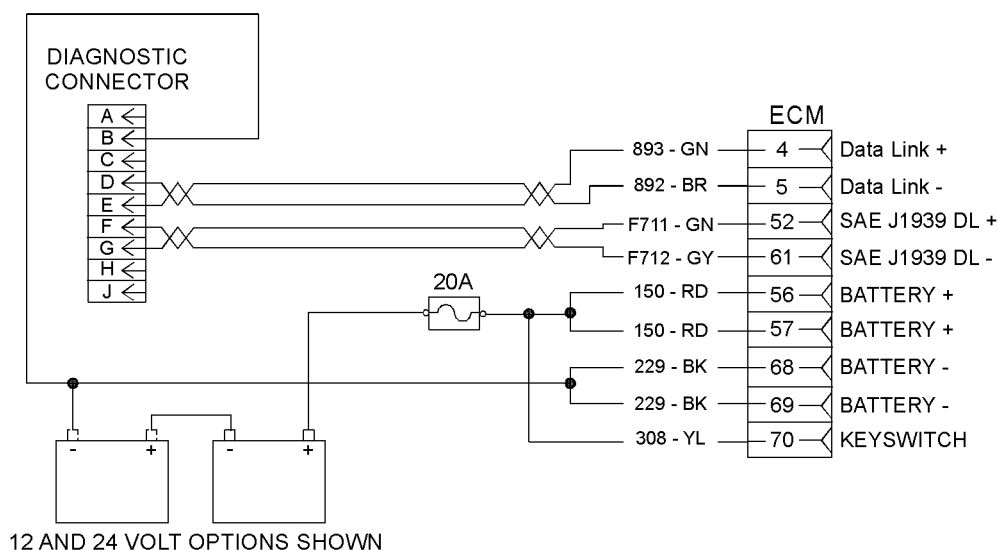


Illustration 80

g01331604

Bypass harness

Note: This bypass harness is only for test applications. This bypass harness may be left only temporarily on the engine. The bypass harness can be used in order to determine if the cause of the intermittent fault is the interruption of the power supply from the battery to the ECM or to the keyswitch circuit.

- A. Turn the keyswitch to the OFF position.
- B. Disconnect harness connector J1/P1 from the ECM.
- C. Remove the 20 Amp in-line fuse from the bypass harness and connect the harness to the ECM connector J1.

Note: This bypass directly connects the circuit for the keyswitch to the ECM. The ECM will remain powered until the connection to the unswitched battery line "+" is disconnected from the battery post. The removal of the 20 Amp fuse will ensure that the ECM will remain without power while connections are being made. The 20 Amp fuse should also be removed before disconnecting the battery connections.

- D. Connect an electronic service tool to the diagnostic connector. Connect the battery + and the battery - directly to the battery in order to ensure the correct polarity.
- E. Replace the 20 Amp in-line fuse. Verify that communication from the electronic service tool is established. Perform any necessary diagnostic tests.

- F. Remove the 20 Amp in-line fuse. Disconnect the bypass harness. Restore all wiring to the original condition. Replace the fuse in the disconnected bypass harness.

Expected Result:

Installing the bypass eliminates the fault.

Results:

- OK – The symptoms disappear when the bypass harness is installed. Also, the symptoms return when the bypass harness is removed. The fault is in the wiring that supplies power to the ECM. Repair the wiring that supplies power to the ECM. STOP.
- Not OK

Repair: If the fault still exists, temporarily connect a test ECM. Remove all jumpers and replace all connectors. The test ECM must be programmed with the same parameters as the suspect ECM. Recheck the system for active diagnostic codes and repeat the Test Step. If the fault is eliminated with the test ECM, reconnect the suspect ECM. If the fault returns with the suspect ECM, replace the suspect ECM.

Verify that the repair eliminates the fault.

STOP.

i02619194

Engine Pressure Sensor Open or Short Circuit - Test

System Operation Description:

Use this procedure under the following conditions:

Use this procedure if another procedure has directed you here. Also use this procedure when there is an active fault for any of the following sensors:

- Oil pressure sensor
- The sensor for the intake manifold pressure

The following background information is related to this procedure:

The troubleshooting procedures for the diagnostic codes of each pressure sensor are identical. The 5 volt sensor supply provides power to all 5 volt sensors. The Electronic Control Module (ECM) supplies 5.0 ± 0.2 VDC to terminal "A" of each sensor connector. The sensor common from the ECM connector goes to terminal "B" of each sensor connector. The sensor supply is output short circuit protected. A short circuit to the battery will not damage the circuit inside the ECM.

Pull-up Voltage

The ECM continuously outputs a pull-up voltage on the circuit for the sensor signal wire. The ECM uses this pull-up voltage in order to detect an open in the signal circuit. When the ECM detects the presence of a voltage that is above a threshold on the signal circuit, the ECM will generate an open circuit diagnostic code (03) for the sensor.

If the sensor is disconnected at the sensor connector, the presence of pull-up voltage at the sensor connector indicates that the wires from the sensor connector to the ECM are not open or shorted to ground. If the sensor is disconnected at the sensor connector, the absence of pull-up voltage at the sensor connector indicates an open in the signal wire or a short to ground. If the sensor is disconnected at the sensor connector and the voltage at the sensor connector is different from pull-up voltage, the signal wire is shorted to another wire in the harness.

Use this procedure for the following diagnostic codes:

- 100-03 Engine Oil Pressure Sensor voltage above normal

- 100-04 Engine Oil Pressure Sensor voltage below normal
- 100-10 Engine Oil Pressure Sensor abnormal rate of change
- 102-03 Boost Pressure Sensor voltage above normal
- 102-04 Boost Pressure Sensor voltage below normal
- 102-10 Boost Pressure Sensor abnormal rate of change

Note: The following diagnostic codes should not be active:

- 262-03 5 Volt Sensor DC Power Supply voltage above normal
- 262-04 5 Volt Sensor DC Power Supply voltage below normal

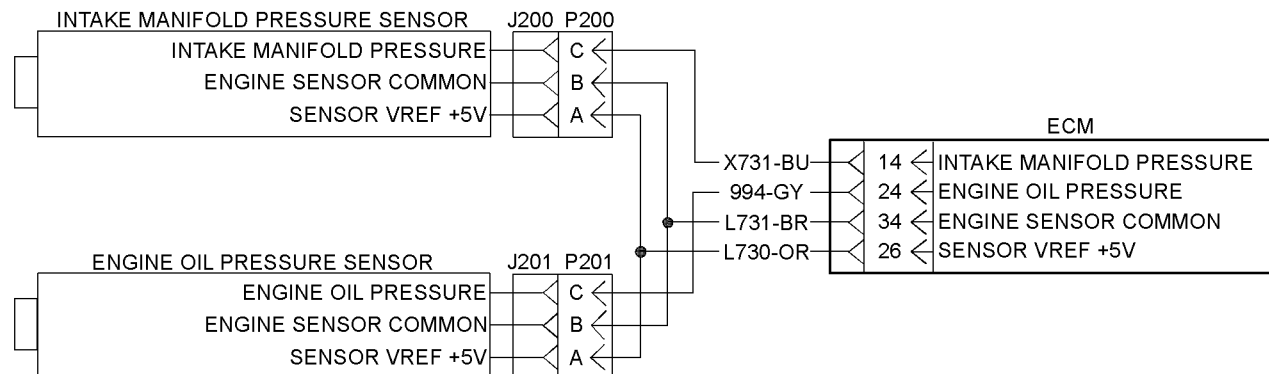


Illustration 81

g01304537

Schematic of pressure sensors

Test Step 1. Check For Active +5 Volt Sensor Supply Diagnostic Codes

- A. Connect the electronic service tool to the diagnostic connector.
- B. Turn the keyswitch to the ON position. Wait at least 15 seconds for activation of the diagnostic codes.
- C. Verify that none of the following diagnostic codes are active:
 - 262-03 5 Volt Sensor DC Power Supply voltage above normal
 - 262-04 5 Volt Sensor DC Power Supply voltage below normal

Expected Result:

No 262 diagnostic codes are active.

Results:

- OK – Proceed to Test Step 2.
- Not OK – A 262 diagnostic code is active.

Repair: Perform the following diagnostic procedure: Troubleshooting, “5 Volt Engine Pressure Sensor Supply Circuit - Test”.

STOP.

Test Step 2. Verify All Active Diagnostic Codes

- A. Turn the keyswitch to the ON position. Wait at least 15 seconds for activation of the diagnostic codes.
- B. Verify if any of the following diagnostic codes are active:

- 100-03 Engine Oil Pressure Sensor voltage above normal
- 100-04 Engine Oil Pressure Sensor voltage below normal
- 100-10 Engine Oil Pressure Sensor abnormal rate of change
- 102-03 Boost Pressure Sensor voltage above normal
- 102-04 Boost Pressure Sensor voltage below normal
- 102-10 Boost Pressure Sensor abnormal rate of change

Expected Result:

One or more of the diagnostic code is active.

Results:

- Yes – Proceed to Test Step 3.
- No

Repair: If the preceding codes are logged, an intermittent condition may be causing the logged codes.

Perform a “Wiggle Test” by using the electronic service tool in order to identify intermittent connections. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

STOP.

Test Step 3. Inspect Electrical Connectors And Wiring

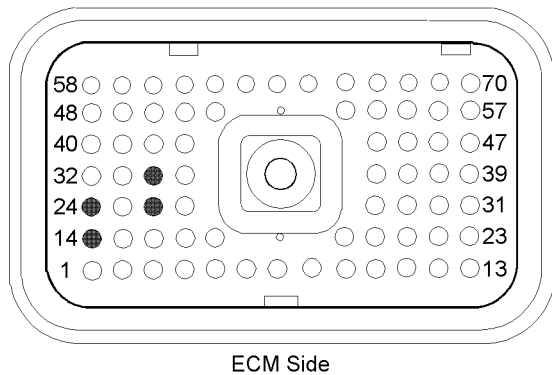


Illustration 82

g01311776

Pin locations on the P1 connector

- (14) Intake manifold pressure
- (24) Engine oil pressure
- (26) +5V supply
- (34) Sensor common

A. Thoroughly inspect the following terminal connections on the P1 ECM connector:

- P1:14 Intake Manifold Pressure
- P1:24 Engine Oil Pressure
- P1:26 +5 V Supply
- P1:34 Sensor Common

B. Thoroughly inspect the following engine pressure sensors:

- J1/P1 ECM Engine Harness Connector
- J20/P20 Machine Interface Connector
- J200/P200 Intake Manifold Pressure Sensor
- J201/P201 Engine Oil Pressure Sensor

C. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

D. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector and the sensor connectors that are associated with the active diagnostic code.

Refer to Illustration 82.

E. Check the ECM connector (Allen head screw) for the correct torque of 6.0 N·m (55 lb in).

F. Check the harness and wiring for abrasions and for pinch points from the sensors back to the ECM.

G. Perform a “Wiggle Test” by using the electronic service tool in order to identify intermittent connections. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

Expected Result:

All connectors, pins, and sockets should be completely coupled and inserted. The harness should be free of corrosion, abrasion, and pinch points.

Results:

- OK – Proceed to Test Step 4.
- Not OK

Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly installed and ensure that the connectors are completely coupled.

Verify that the repair eliminates the fault.

STOP.

Test Step 4. Verify that the Diagnostic Code is Still Active

A. Turn the keyswitch to the ON position. Wait at least 15 seconds for activation of the diagnostic codes.

B. Use the electronic service tool to check for active diagnostic codes. Record all active diagnostic codes.

C. Determine if the fault is related to an open circuit diagnostic code or a short circuit diagnostic code.

Expected Result:

Either a short circuit diagnostic code is active or an open circuit diagnostic code is active.

Results:

- OK - Short circuit – A “voltage above normal” diagnostic code is active. Proceed to Test Step 5.
- OK - Open circuit – A “voltage below normal” diagnostic code is active. Proceed to Test Step 6.
- Not OK – A short circuit diagnostic code is not active. An open circuit diagnostic code is not active. An intermittent fault may exist.

Repair: Perform a “Wiggle Test” by using the electronic service tool in order to identify intermittent connections. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

STOP.

Test Step 5. Disconnect The Sensor In Order To Create An Open Circuit

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the sensor connector of the sensor with the short circuit diagnostic code.
- C. Turn the keyswitch to the ON position. Wait at least 15 seconds for activation of the diagnostic codes.
- D. Use the electronic service tool to check the “Active Diagnostic Code” screen. Check for an open circuit diagnostic code.

Expected Result:

An “voltage above normal” diagnostic code for the disconnected sensor is now active.

Results:

- OK – A “voltage below normal” diagnostic code was active before disconnecting the sensor. An “voltage above normal” diagnostic code became active after disconnecting the sensor. Proceed to Test Step 7.
- Not OK – There is a short circuit between the sensor harness connector and the ECM. Leave the sensor disconnected. Proceed to Test Step 9.

Test Step 6. Measure the Sensor Supply Voltage

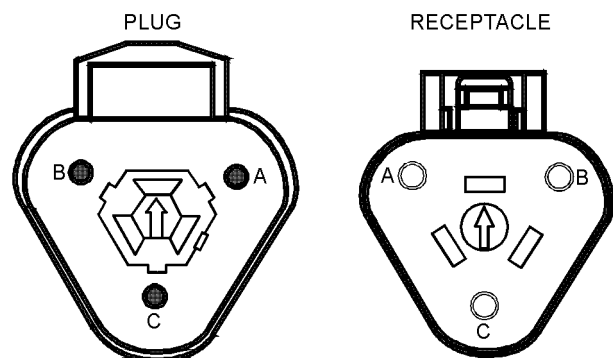


Illustration 83

g01311778

Terminals for the pressure sensor connector

- (A) +5V supply
- (B) Sensor common
- (C) Signal

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the sensor from the engine harness.
- C. Connect a 3-Terminal Breakout T to the engine harness only. Do not connect the sensor to the Breakout T.
- D. Turn the keyswitch to the ON position.
- E. Measure the voltage between terminal “A” (+5V supply) and terminal “B” (sensor common).

Expected Result:

The DC voltage between terminal “A” and terminal “B” measures 4.5 to 5.5 Volts DC.

Results:

- OK – The sensor supply voltage is correct. Remove the Breakout T. Proceed to Test Step 8.
- Not OK – The sensor supply voltage is out of the nominal range. Continue testing the sensor supply circuit.

Repair: Proceed to the following repair: Troubleshooting, “5 Volt Engine Pressure Sensor Supply Circuit - Test”

STOP.

Test Step 7. Determine If The Short Circuit Is In The Connector Or In The Sensor

- A. Thoroughly inspect the connector for moisture.
- B. Inspect the seals and reconnect the sensor.
- C. Refer to Troubleshooting, “Electrical Connectors - Inspect”.
- D. If the “voltage below normal” diagnostic code reappears, the sensor or the sensor connector has a fault.
 - a. Temporarily connect a new sensor to the harness, but do not install the new sensor in the engine.
- E. Use the electronic service tool to verify that there is a “voltage below normal” diagnostic code. The new sensor should be connected to the harness at this time.

Expected Result:

The “voltage below normal” diagnostic code is not present when a new sensor is connected.

Results:

- OK – Verify that the repair eliminates the fault. Use the electronic service tool to clear the logged diagnostic codes. STOP.
- Not OK – Repair the engine harness connector. Use the electronic service tool to clear the logged diagnostic codes. STOP.

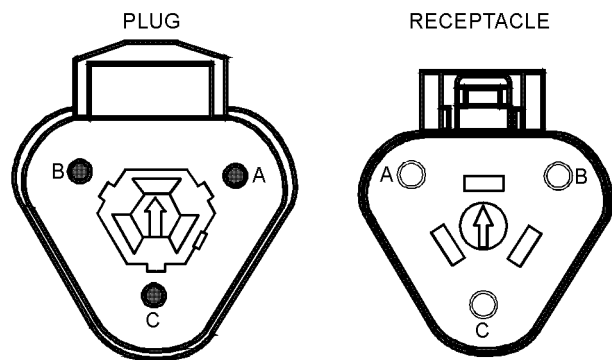
Test Step 8. Create a Short Circuit Between the Signal and the Common Terminals at the Engine Harness Connector


Illustration 84

g01311778

Terminals for the pressure sensor connector

- (A) +5V supply
(B) Sensor common
(C) Signal

- Turn the keyswitch to the ON position.
- Fabricate a jumper wire 150 mm (6 inch) long. Crimp a Deutsch terminal to both ends of the wire.
- Monitor the “Active Diagnostic Code” screen of the electronic service tool before installing the jumper wire and after installing the jumper wire.
- Install the jumper on the engine harness connector. Install one end of the jumper at the sensor signal (terminal “C”). Install the other end of the jumper at the common connection for the pressure sensor (terminal “B”). Wait at least 15 seconds for activation of the “voltage below normal” diagnostic code.

Refer to Illustration 84.

Expected Result:

A “voltage below normal” diagnostic code is active when the jumper is installed. An “voltage above normal” diagnostic code is active when the jumper is removed.

Results:

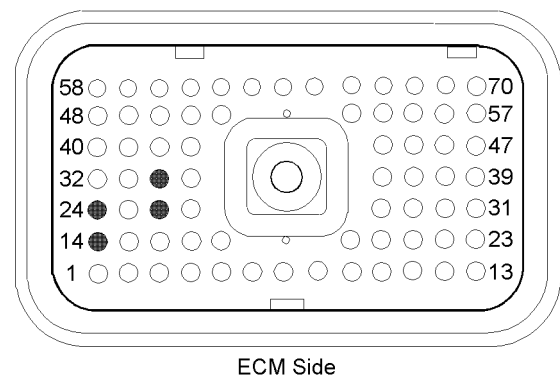
- OK – The engine harness and the ECM are OK.

Repair: Perform the following repair:

- Temporarily connect the suspect sensor.
- Use the electronic service tool to verify if the diagnostic code remains active.
- If the diagnostic code is active, install a new sensor.
- Use the electronic service tool to verify that the repair eliminated the fault.

STOP.

- Not OK – The “voltage above normal” diagnostic code remains active when the jumper is installed. The most probable location for the open circuit is in the common wire for the sensor or in the sensor signal wire of the engine harness between the ECM and the sensor. Remove the jumper. Proceed to test step 9.

Test Step 9. Check the Operation of the ECM by Creating Open and Short Circuits at the ECM Connector


ECM Side

Illustration 85

g01311776

Pin locations on the P1 connector

- (14) Intake manifold pressure
(24) Engine oil pressure
(26) +5V supply
(34) Sensor common

- Turn the keyswitch to the OFF position.
- Disconnect J1/P1.ECM connector. Thoroughly inspect both halves of the connectors for signs of corrosion or moisture.
- Refer to Troubleshooting, “Electrical Connectors - Inspect”.
- Reconnect J1/P1 ECM connector.

- E. Turn the keyswitch to the ON position. Monitor the "Active Diagnostic Code" screen of the electronic service tool. Wait at least 15 seconds for activation of the code.

A "voltage above normal" diagnostic code should be active for the suspect sensor.

Note: When the engine harness is disconnected, all of the "voltage above normal" diagnostic codes for the pressure sensors will be active. This is normal. Disregard the diagnostic codes for the other pressure sensors. Check the diagnostic codes for the suspect sensor only.

- F. Turn the keyswitch to the OFF position.
- G. Fabricate a jumper wire 150 mm (6 inch) long. Crimp a Deutsch socket to both ends of the wire.
- H. Install the jumper wire on the ECM connector J1. Insert the jumper wire between the terminal for the suspect sensor signal and the common connection for the engine's pressure sensor (terminal 3).

Refer to Illustration 85 for the ECM connectors.

- I. Turn the keyswitch to the ON position.
- J. Use the electronic service tool to verify that there is a "voltage below normal" diagnostic code.

Expected Result:

A "voltage below normal" diagnostic code is active.

Results:

- OK – The ECM is operating properly. Proceed to Test Step 10.
- Not OK – One of the following conditions exists: The "voltage above normal" diagnostic code is not active when the harness is disconnected. The "voltage below normal" diagnostic code is not active when the jumper wire is installed.

Repair: Perform the following repair:

1. Temporarily connect a test ECM.

Note: The test ECM should have the same values and the same parameters as the suspect ECM.

2. Remove all jumpers and replace all connectors.
3. Use the electronic service tool to recheck the system for active diagnostic codes.
4. Repeat the test step.
5. If the fault is resolved with the test ECM, reconnect the suspect ECM.

6. If the fault returns with the suspect ECM, replace the ECM.

7. Verify that the repair eliminates the fault.

STOP.

Test Step 10. Bypass the Harness Wiring Between the ECM and the Sensor Connector

- A. Turn the keyswitch to the OFF position.
- B. Disconnect J1/P1 ECM connector and the sensor connector.
- C. Remove the sensor signal wire from the ECM connector.
- D. Remove the signal wire (terminal "C") from the sensor connector on the engine harness.
- E. Fabricate a jumper wire that is long enough to reach from the ECM to the sensor connector or use an engine sensor harness bypass with 3 terminals.

Note: If an engine sensor harness bypass is being made, crimp a Deutsch socket on one end in order to connect to the ECM. Crimp either a Deutsch pin or a Deutsch socket on the other end, as required.

- F. Insert the one end of the engine sensor harness bypass into P1 ECM connector on the engine harness. Insert the other end of the engine sensor harness bypass into the sensor connector of the engine harness.
- G. Reconnect J1/P1 ECM engine connector and the sensor connector.
- H. Turn the keyswitch to the ON position.
- I. Use the electronic service tool to monitor the "Active Diagnostic Code" screen for either the open circuit diagnostic code for the sensor or the short circuit diagnostic code for the sensor.

Expected Result:

The diagnostic code disappears when the jumper or the bypass is installed.

Results:

- OK – There is a fault in the wiring harness.

Repair: Perform the following repair:

1. Repair the faulty wiring harness or replace the faulty wiring harness.
2. Clear all diagnostic codes.

3. Use the electronic service tool in order to verify that the repair eliminates the fault.

STOP.

- Not OK – Restart this test procedure from Test Step 1 and carefully perform each step.

i02619758

Engine Temperature Sensor Open or Short Circuit - Test

System Operation Description:

Use this procedure under the following conditions:

This procedure covers open circuit diagnostic codes and short circuit diagnostic codes that are associated with the following sensors:

- Coolant temperature sensor
- Intake manifold air temperature sensor

Use this procedure to troubleshoot the system when one of the following diagnostic codes is active or a diagnostic code has been recently logged or when a diagnostic code can easily be activated.

- 0105-03 Inlet Manifold Temperature Sensor voltage above normal
- 0105-04 Inlet Manifold Temperature Sensor voltage below normal
- 0110-03 Engine Coolant Temperature Sensor voltage above normal
- 0110-04 Engine Coolant Temperature Sensor voltage below normal

The following background information is related to this procedure:

The troubleshooting procedures for the diagnostic codes of each temperature sensor are identical. The temperature sensors are sensors that have two terminals. The connector P1:34 Electronic Control Module (ECM) is the common connection for the engine temperature sensors. The sensor common connection is shared between the temperature sensors. The common line is connected to each sensor connector terminal 2. Terminal 1 is the sensor output. The signal voltage from terminal 1 of each sensor is supplied to the appropriate terminal at ECM Connector P1/J1.

Pull-up Voltage

The ECM continuously outputs a pull-up voltage on the circuit for the sensor signal wire. The ECM uses this pull-up voltage in order to detect an open in the signal circuit. When the ECM detects the presence of a voltage that is above a threshold on the signal circuit, the ECM will generate an open circuit diagnostic code (3) for the sensor.

If the sensor is disconnected at the sensor connector, the presence of pull-up voltage at the sensor connector indicates that the wires from the sensor connector to the ECM are not open or shorted to ground. If the sensor is disconnected at the sensor connector, the absence of pull-up voltage at the sensor connector indicates an open in the signal wire or a short to ground. If the sensor is disconnected at the sensor connector and the voltage at the sensor connector is different from pull-up voltage, the signal wire is shorted to another wire in the harness.

The troubleshooting procedures for the diagnostic codes of each temperature sensor are identical. The temperature sensors are passive sensors. The temperature sensor has two terminals. The common line is connected to each sensor connector terminal 2. The signal voltage from terminal 1 of each sensor is supplied to the appropriate terminal at the P2/J2 ECM connector.

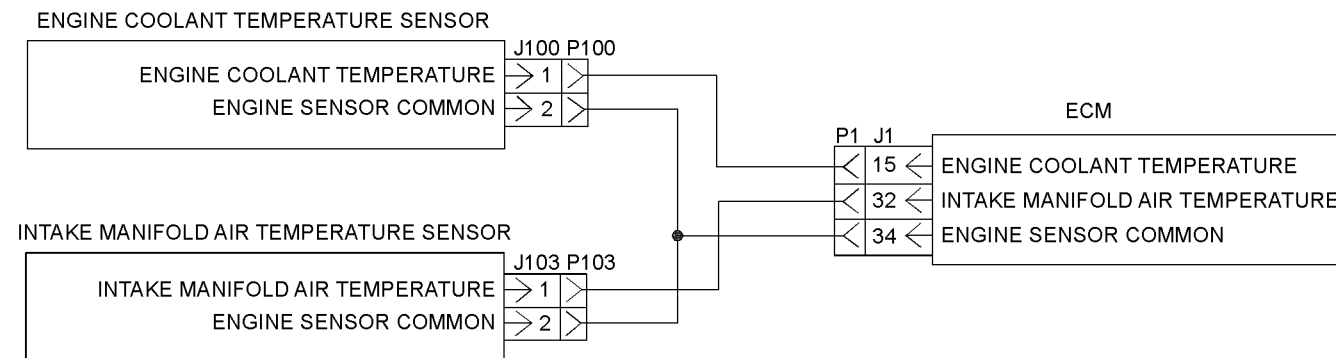


Illustration 86

Schematic for engine temperature sensors

g01312262

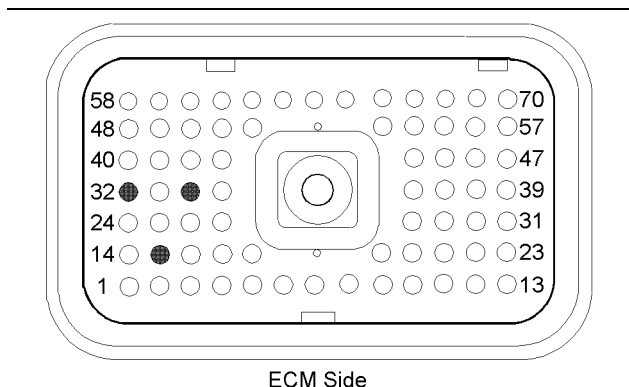


Illustration 87

g01312270

Pin locations on the P1 connector

- (15) Engine coolant temperature
- (32) Intake manifold air temperature
- (34) Sensor common

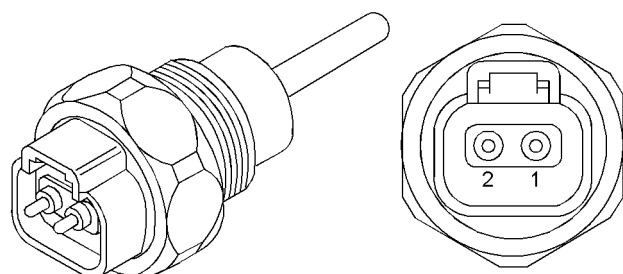


Illustration 88

g01312273

Pin locations on the temperature sensors

- (1) Temperature signal
- (2) Sensor common

Test Step 1. Verify All Active Diagnostic Codes

- A. Connect the electronic service tool to the diagnostic connector.

- B. Turn the keyswitch to the ON position.

Note: Wait at least 15 seconds for activation of the diagnostic codes.

- C. Use the electronic service tool in order to verify if any of the following diagnostic codes are active:

- 105-03 Inlet Manifold Temperature Sensor voltage above normal
- 105-04 Inlet Manifold Temperature Sensor voltage below normal
- 110-03 Engine Coolant Temperature Sensor voltage above normal
- 110-04 Engine Coolant Temperature Sensor voltage below normal

Expected Result:

One or more of the preceding diagnostic codes are active.

Results:

- Yes – Proceed to Test Step 2.
- No

Repair: The fault is intermittent. Perform a “Wiggle Test”. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

STOP.

Test Step 2. Inspect Electrical Connectors And Wiring

- A. Thoroughly inspect ECM engine harness connector J1/P1 and the suspect sensor connector. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

- B.** Perform a 45 N (10 lb) pull test on each of the wires in the sensor connector and the ECM connector that are associated with the active diagnostic code.

Refer to Illustration 87.

- C.** Verify that the latch tab of the connector is properly latched. Verify that the latch tab of the connector has returned to the fully latching position.
- D.** Check the ECM connector (Allen head screw) for the correct torque of 6.0 N·m (55 lb in).
- E.** Check the harness and wiring for abrasions and for pinch points from the sensor to the ECM.

Expected Result:

All connectors, pins, and sockets should be completely coupled and/or inserted. The harness and wiring should be free of corrosion, abrasion, and pinch points.

Results:

- OK – Proceed to Test Step 3.
- Not OK

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

Ensure that all of the seals are correctly installed and ensure that the connectors are completely coupled.

Clear all inactive diagnostic codes and verify that the repair has eliminated the fault.

Proceed to test step 3 if the fault has not been eliminated.

Test Step 3. Verify That The Diagnostic Code Is Still Active

- A.** Turn the keyswitch to the ON position.

Note: Wait at least 15 seconds for activation of the diagnostic codes.

- B.** Access the “Active Diagnostic Code” screen on the electronic service tool and check for active diagnostic codes.
- C.** Determine if the fault is related to an open circuit diagnostic code or a short circuit diagnostic code.

Expected Result:

A Voltage Below Normal diagnostic code or an Voltage Above Normal diagnostic code is active.

Results:

- OK - SHORT Circuit – A Voltage Below Normal diagnostic code is active at this time. Proceed to Test Step 4.
- OK - OPEN Circuit – An Voltage Above Normal diagnostic code is active at this time. Proceed to Test Step 5.
- Not OK – A Voltage Below Normal diagnostic code is not active. An Voltage Above Normal diagnostic code is not active. An intermittent fault may exist.

Repair: Use the electronic service tool to perform a “Wiggle Test”. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

If faults are indicated then go to the appropriate procedure.

STOP.

Test Step 4. Disconnect The Sensor In Order To Create An Open Circuit.

- A.** Turn the keyswitch to the OFF position.

- B.** Disconnect the sensor connector of the sensor with the “voltage below normal” diagnostic code.

- C.** Turn the keyswitch to the ON position.

Note: Wait at least 15 seconds for activation of the diagnostic codes.

- D.** Access the “Active Diagnostic Code” screen of the electronic service tool. Check for an active “voltage above normal” diagnostic code.

Expected Result:

An “voltage above normal” diagnostic code for the disconnected sensor is now active.

Results:

- OK – A “voltage below normal” diagnostic code was active before disconnecting the sensor. A “voltage above normal” diagnostic code became active after disconnecting the sensor.

Repair: Refer to Troubleshooting, “Electrical Connectors - Inspect”.

Connect the sensor and verify that the fault returns.

Temporarily connect a new sensor to the connector on the engine harness.

Verify that the fault has been eliminated.

If the fault has been eliminated, install the new sensor.

Clear all inactive diagnostic codes.

STOP.

- Not OK – There is a short circuit between the sensor harness connector and the ECM. Leave the sensor disconnected. Proceed to Test Step 6.

Test Step 5. Create A Short Circuit Between The Signal And The Common Terminals At The Sensor Harness Connector

A. Disconnect the suspect sensor connector P100 for the coolant temperature sensor or disconnect P103 for the inlet manifold air temperature sensor.

B. Turn the keyswitch to the ON position.

Note: Wait at least 10 seconds for the activation of any diagnostic fault codes.

C. Fabricate a jumper wire 150 mm (6 inch) long. Crimp a terminal to both ends of the wire.

D. Monitor the “Active Diagnostic Code” screen on the electronic service tool before installing the jumper wire and after installing the jumper wire.

E. Install the jumper on the engine harness connector for the suspect sensor, P100 for the coolant temperature sensor and P103 for the intake manifold air temperature sensor. Install one end of the jumper at the sensor signal (terminal 1). Install the other end of the jumper at the common connection (terminal 2).

Note: Wait at least 30 seconds for activation of the “voltage below normal” diagnostic code.

Expected Result:

A “voltage below normal” diagnostic code is active when the jumper is installed. An “voltage above normal” diagnostic code is active when the jumper is removed.

Results:

- OK – The engine harness and the ECM are OK.

Repair: Perform the following repair:

1. Temporarily connect the suspect sensor.
2. If the diagnostic code remains active, replace the sensor.
3. Verify that the repair eliminates the fault.

4. Clear all logged diagnostic codes.

STOP.

- Not OK – The “voltage above normal” diagnostic code remains active with the jumper in place. The most probable location for the open circuit is in the sensor common or the sensor signal wire in the engine harness between the ECM and the sensor. Remove the jumper. Proceed to Test Step 6.

Test Step 6. Check The Operation Of The ECM By Creating An Open And A Short Circuit At The ECM Connector

A. Turn the keyswitch to the OFF position.

B. Disconnect the J1/P1 ECM connector.

C. Thoroughly inspect both halves of the connector for signs of corrosion or moisture. Refer to Troubleshooting, “Electrical Connectors - Inspect”.

D. Connect a 70 pin breakout harness to connector J1 and connector P1.

E. Turn the keyswitch to the ON position. Use the electronic service tool in order to monitor the “Active Diagnostic Code” screen. Wait at least 15 seconds for activation of the code.

A “voltage above normal” diagnostic code should be active for the suspect sensor.

Note: When the engine harness is disconnected, all of the “voltage above normal” diagnostic codes for the pressure sensors and the temperature sensors will be active. This is normal. Disregard the diagnostic codes for the pressure sensors and the temperature sensors that are not suspect.

F. Turn the keyswitch to the OFF position.

G. Fabricate a jumper wire 150 mm (6 inch) long. Crimp a Deutsch terminal to both ends of the wire.

H. Monitor the “Active Diagnostic Code” screen on the electronic service tool before installing the jumper wire and after installing the jumper wire.

I. Install the jumper on the engine harness connector. Install one end of the jumper to the terminal for the sensor signal on the bypass harness. Install the other end of the jumper in the terminal 34 common connection for the bypass harness. Wait at least 15 seconds for activation of the “voltage below normal” diagnostic code.

Expected Result:

A "voltage below normal" diagnostic code is active when the jumper is installed. An "voltage above normal" diagnostic code is active when the jumper is removed.

Results:

- OK – Proceed to test step 7.
- Not OK

Repair: The ECM does not operate correctly.

1. Temporarily connect a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value of the suspect ECM.

2. Remove all jumpers and replace all connectors.
3. If the fault is eliminated with the test ECM, install the suspect ECM and verify that the fault returns.
4. If the fault returns replace the suspect ECM.
5. Verify that the repair eliminates the fault.
6. Remove the 70 pin breakout harness and reconnect connector P1 to connector J1.

STOP.

Test Step 7. Bypass The Harness Wiring Between The ECM And The Sensor Connector

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the J1/P1 connector for the ECM harness, and the suspect sensor connector.
- C. Remove the sensor signal wire from the P1 ECM connector.
- D. Remove the signal wire (terminal 1) from the sensor connector on the engine harness.
- E. Fabricate a jumper wire that is long enough to reach from the ECM to the sensor connector with Deutsch sockets on both ends.
- F. Insert one end of the jumper into the ECM connector. Insert the other end of the jumper into the sensor connector of the engine harness.
- G. Reconnect the connector for the ECM harness and the sensor connector.
- H. Turn the keyswitch to the ON position.

- I. Use the electronic service tool in order to monitor the "Active Diagnostic Code" screen for either the "voltage above normal" diagnostic code for the sensor or the "voltage below normal" diagnostic code for the sensor.

Expected Result:

The diagnostic code disappears when the jumper is installed.

Results:

- OK – There is a fault in the wiring harness.

Repair: Perform the following repair:

1. Repair the faulty wiring harness or replace the faulty wiring harness.
2. Clear all diagnostic codes.
3. Verify that the repair eliminates the fault.

STOP.

- Not OK – Restart this procedure from Test Step 1 and carefully perform each step.

i02621450

Fuel Injection Pump Circuit - Test

System Operation Description:

Use this procedure under the following conditions:

Use this procedure if another procedure has directed you here. Also use this procedure if any of the following diagnostic codes are active:

- 1684-04 Fuel Injection Pump voltage below normal
- 1684-07 Fuel Injection Pump not responding properly
- 1684-11 Fuel Injection Pump other failure mode
- 1684-14 Fuel Injection Pump special instruction
- 174-02 Fuel Temperature Sensor erratic, intermittent, or incorrect

The following background information is related to this procedure:

The fuel injection pump receives an electrical supply from the electrical system on the machine and from the relay for the fuel injection pump through the Machine Interface Connector (MIC).

A loss of power to the fuel injection pump can occur on either the positive side or the negative side of the pump.

The positive side is supplied from the pump power relay through the Voltage Load Protection Module (VLPM) to the fuel injection pump.

The positive supply includes an in-line 30 amp fuse in order to protect the circuit. The negative side is connected directly to the battery.

Note: The engine protection system (if equipped) and the engine shutdown system (if equipped) have the ability to disconnect the electrical power from the fuel injection pump. The engine protection system will disconnect the electrical power supply to the Electronic Control Module (ECM). The loss of electrical power to the engine will cause the engine to shutdown. The engine protection devices can be at fault when the engine is difficult to start. Some engine protection systems will not supply power to the system until the crankshaft rotates, and the oil pressure achieves a safe level or until an override button is activated. These devices may be the cause of intermittent power loss or a complete loss of power to the fuel injection pump.

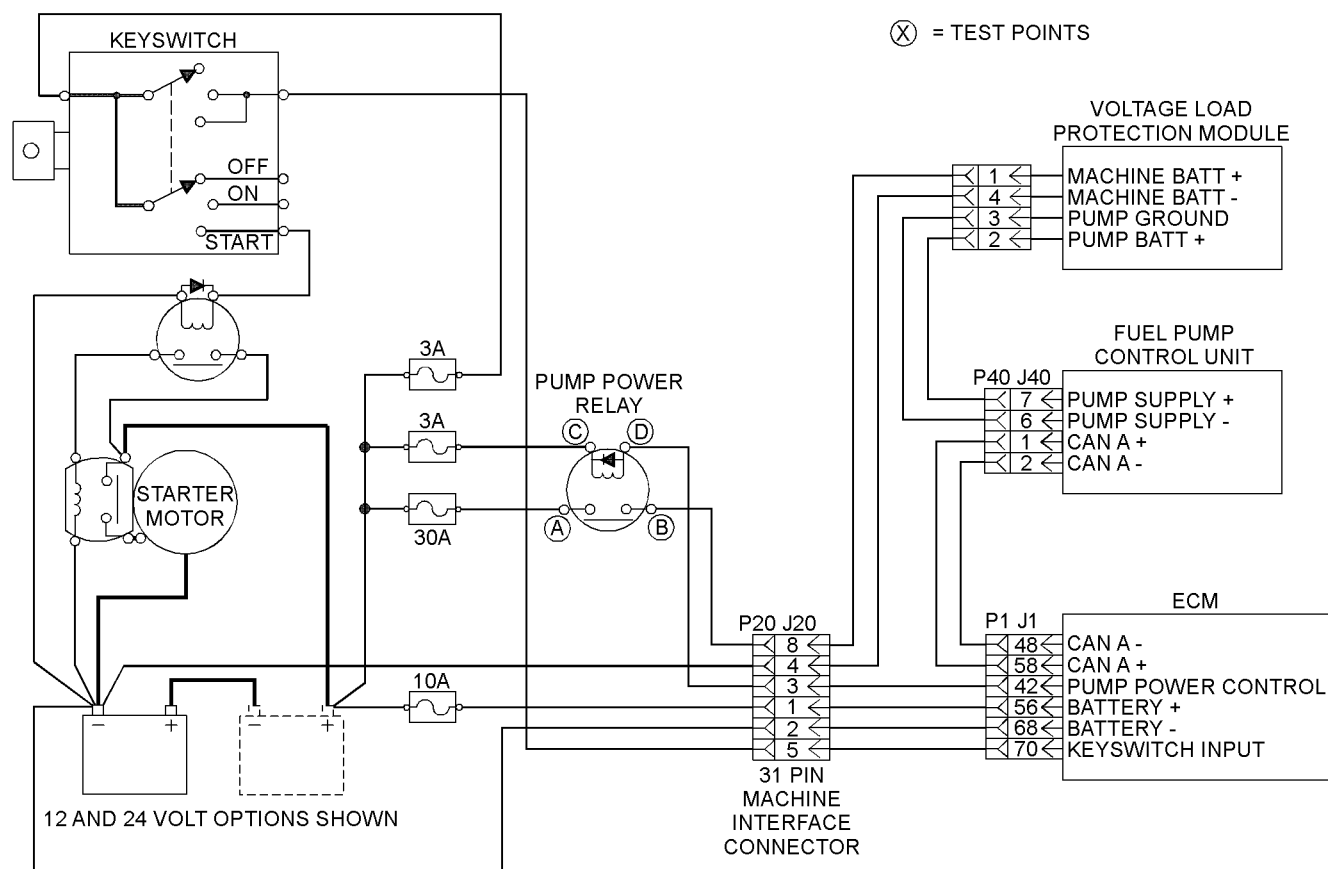


Illustration 89

Schematic for the fuel injection pump (31 pin MIC)

g01308672

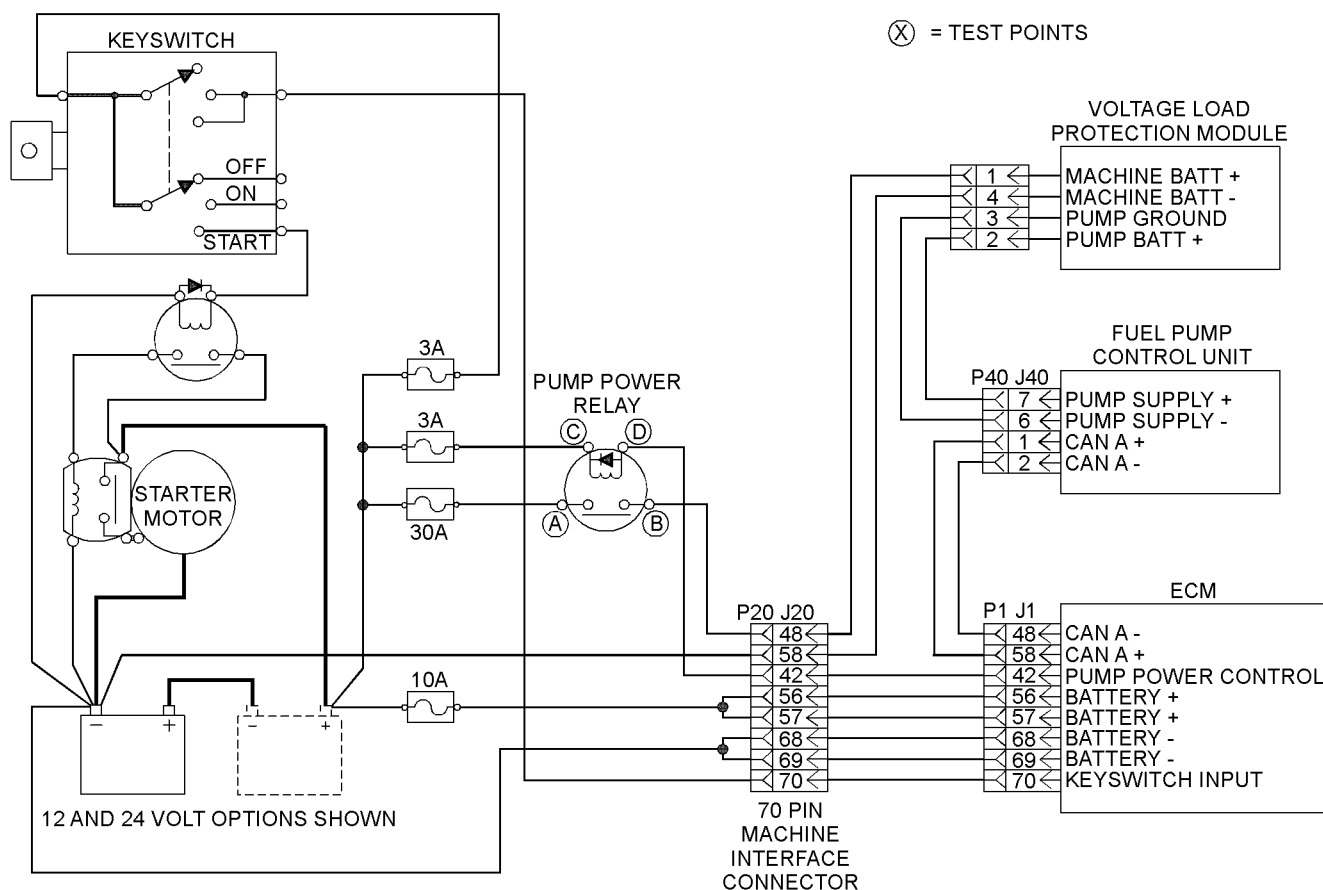


Illustration 90

Schematic for the fuel injection pump (70 pin MIC)

g01308607

Test Step 1. Check the Battery Voltage

A. Measure no-load battery voltage at the battery terminals.

Expected Result:

The battery voltage should be no less than 11.0 volts for a 12 volt system.

The battery voltage should be no less than 22.0 volts for a 24 volt system.

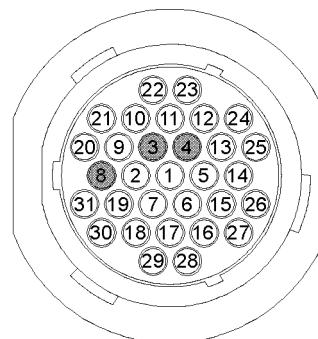
Results:

- OK – Proceed to Test Step 2.
- Not OK – The battery voltage is below normal.

Repair: Recharge the batteries or replace the batteries. Use the electronic service tool to clear any logged diagnostic codes and then verify that the repairs have eliminated the fault.

STOP.

Test Step 2. Inspect the Electrical Connectors and Wiring



31 Pin MIC (P20)

Illustration 91

Pin locations on the 31 pin MIC

- (3) Fuel pump power control
- (4) Fuel pump battery -
- (8) Fuel pump battery +

g01312677

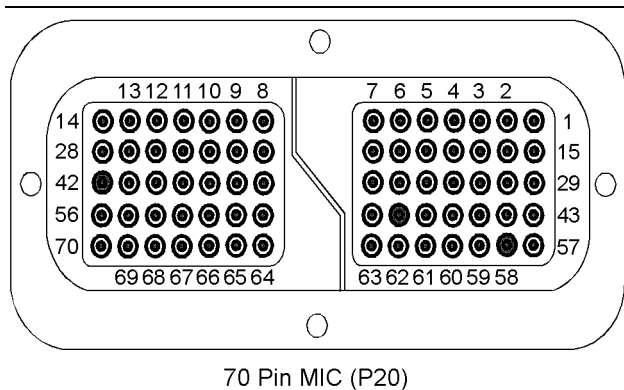


Illustration 92

g01312678

Pin locations on the 70 pin MIC

- (42) Fuel pump power control
 (48) Fuel pump battery +
 (58) Fuel pump battery -

A. Thoroughly inspect the following terminal connections on the P40 Fuel Injection Pump Connector:

- P40:6 Pump Supply -
- P40:7 Pump Supply +

Refer to Troubleshooting, "Electrical Connectors - Inspect".

B. Inspect the terminals on the VLPM connector.

C. On applications that have a 31 pin MIC, thoroughly inspect the following terminal connections on the P20/J20 Machine Interface Connector.

- P20: 3 Pump Power Control
- P20: 4 Pump Supply -
- P20: 8 Pump Supply +

D. On applications that have a 70 pin MIC, thoroughly inspect the following terminal connections on the P20/J20 Machine Interface Connector.

- P20: 42 Pump Power Control
- P20: 48 Pump Supply +
- P20: 58 Pump Supply -

E. Perform a 45 N (10 lb) pull test on each of the wires in the 31 pin MIC that are associated with the following connections:

- P20:3 Pump Power Control
- P20:4 Pump Supply -
- P20:8 Pump Supply +

F. Perform a 45 N (10 lb) pull test on each of the wires in the 70 pin MIC that are associated with the following connections:

- P20:42 Pump Power Control
- P20:48 Pump Supply +
- P20:58 Pump Supply -

G. Check the ECM connector (Allen head screw) for the correct torque of 6.0 N·m (55 lb in).

H. Check the harness and wiring for abrasions and for pinch points from the battery to VLPM and from the ECM and the fuel pump. Also, check the harness and wiring for abrasions and for pinch points from the keyswitch to the ECM.

Expected Result:

All connectors, pins, and sockets should be completely coupled and/or inserted. The harness and wiring should be free of corrosion, abrasion, and/or pinch points.

Results:

- OK – Proceed to Test Step 3.
- Not OK – There is a fault in the wiring or connectors. Repair the wiring and/or connectors or replace the wiring and/or connectors. Verify that the repair has eliminated the fault. STOP.

Test Step 3. Check the Supply Voltage at the Fuel Injection Pump

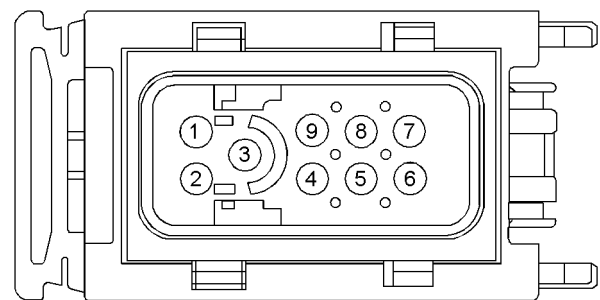


Illustration 93

g01320290

Locations of the pins on the fuel injection pump connector P40.

- (6) Pump Supply -
 (7) Pump Supply +

A. Turn the keyswitch to the OFF position.

B. Disconnect the P40 connector from the fuel injection pump.

C. Turn the keyswitch to the ON position.

D. Measure the voltage between P40:7 Pump Supply + and P40:6 Pump Supply -.

Expected Result:

The measured voltage is between 11.0 VDC and 13.5 VDC for a 12 volt system and between 22.0 VDC and 27.0 VDC for a 24 volt system with no suspected intermittent faults.

Results:

- OK – The voltage is within the limits. Proceed to Test Step 4.
- Not OK – The voltage is below the limits. Proceed to Test Step 5.

Test Step 4. Check the Drop in the Supply Voltage at the Fuel Injection Pump

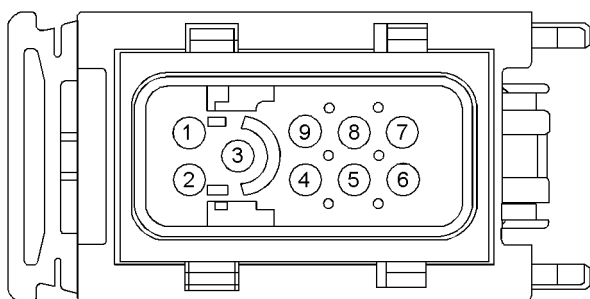


Illustration 94
Pin locations on the fuel injection pump connector P40.
(6) Pump Supply -
(7) Pump Supply +

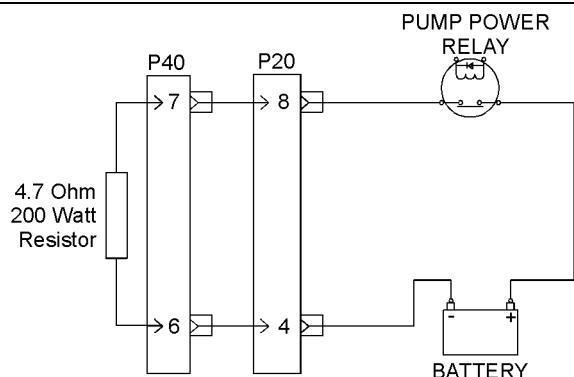


Illustration 95
Test harness (31 PIN mic)

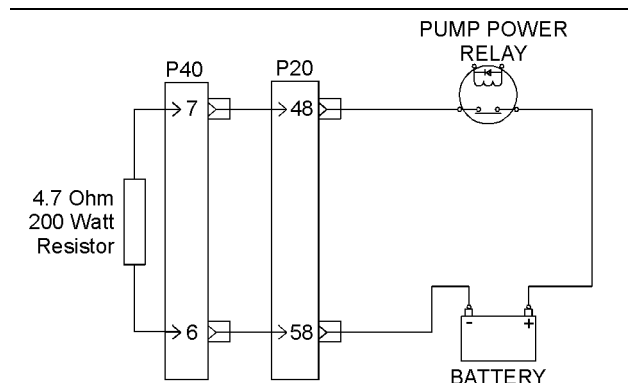


Illustration 96
Test harness (70 PIN mic)

- Fabricate a test harness. Two wires require a Deutsch 10G pin on one end. The other end of each wire is connected to a 4.7 Ohm, 200 Watt resistor. Refer to Illustration 96.
 - Make sure that the keyswitch is in the OFF position.
- Note:** In the following test, the resistor simulates the load from the fuel injection pump.
- Connect the test harness between pins P40:6 and P40:7.
 - Set a multimeter to “mVolts”. Connect the multimeter between pin P40:7 and the battery+ terminal.
 - Turn the keyswitch to the ON position and then measure the voltage drop. Record the result.
 - Set a multimeter to “mVolts”. Connect the multimeter between pin P40:6 and the battery-terminal.
 - Measure the voltage drop. Record the result.
 - Add the results that were obtained in steps E. and G.. The total voltage should be less than 1.0 Volts DC.
 - Turn the keyswitch to the OFF position.
 - Remove the test harness and then reconnect the P40 connector to the fuel injection pump.

Expected Result:

The total measured voltage drop is less than 1.0 Volts DC.

Results:

- OK – The wiring harness and the voltage supply to the fuel injection pump are correct.

Repair: The fault is in the fuel injection pump or there is a communication fault between the ECM and the fuel injection pump. Refer to Troubleshooting, "CAN Data Link Circuit - Test". If the CAN data link is correct, the fault is in the fuel injection pump. Contact your Perkins distributor in order to check if the software version is correct. Also check that there have been no software updates. If the fault still exists, contact your Perkins distributor in order to change the fuel injection pump. The warranty of the fuel injection pump will be affected if the pump is replaced without prior consultation.

Replace the fuel injection pump. Refer to Disassembly and Assembly, "Fuel Injection Pump - Remove" and Disassembly and Assembly, "Fuel Injection Pump - Install".

Use the electronic service tool to clear any logged diagnostic codes and then verify that the repairs have eliminated the fault.

STOP.

- Not OK – The total measured voltage drop is more than 1.0 Volts DC.

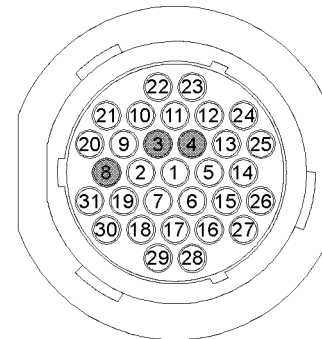
Repair: There is a faulty connector in the circuit that is causing a resistance in the harness. Repeat the test for each connector in the circuit, until the cause of the fault is identified.

Repair the connector or replace the connector that is causing the voltage drop in the supply to the fuel injection pump.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

Test Step 5. Check the Supply Voltage at the Machine Interface Connector



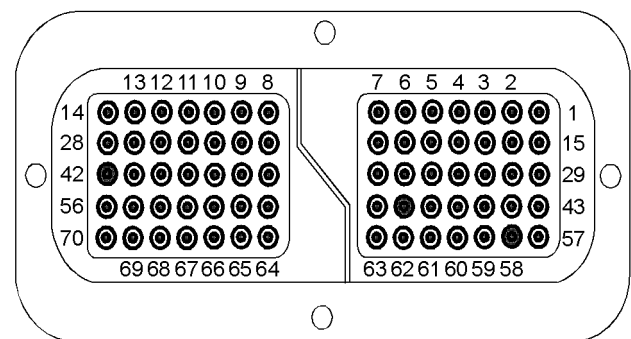
31 Pin MIC (P20)

Illustration 97

g01312677

Pin locations on the 31 pin MIC

- (3) Fuel pump power control
- (4) Fuel pump battery -
- (8) Fuel pump battery +



70 Pin MIC (P20)

Illustration 98

g01312678

Pin locations on the 70 pin MIC

- (42) Fuel pump power control
- (48) Fuel pump battery +
- (58) Fuel pump battery -

- On applications with a 31 pin MIC, insert multimeter probes into J20:8 Battery + and J20:4 Battery -.
- On applications with a 70 pin MIC, insert multimeter probes into J20:48 Battery + and J20:58 Battery -.
- Connect a multimeter between the probes and ensure that the meter is set to zero.
- Turn the keyswitch to the ON position and measure the supply voltage to the VLPM.

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12.0 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24.0 Volt system.

Results:

- OK – The voltage is within limits. There is a fault in the engine harness. Proceed to Test Step 6.
- Not OK – The voltage is below the limits. There is a fault in the machine harness. Proceed to Test Step 8.

Test Step 6. Check the Supply Voltage at the Input to the Voltage Load Protection Module (VLPM)

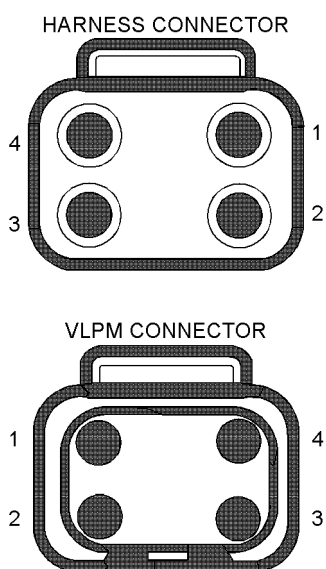


Illustration 99

g01313212

Pin locations on the VLPM connector

- Insert multimeter probes in pin 1 (Battery +) of the VLPM connector and pin 4 (Battery -) of the VLPM connector.
- Connect a multimeter between the probes and ensure that the meter is set to zero.
- Turn the keyswitch to the ON position and measure the supply voltage to the VLPM.

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12.0 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24.0 Volt system.

Results:

- OK – The voltage is within limits. Proceed to Test Step 7.

- Not OK – The voltage is below the limits.

Repair: There is a fault in the engine harness between the MIC and the VLPM.

Repair the engine harness or replace the engine harness.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

Test Step 7. Check the Supply Voltage at the Output from the Voltage Load Protection Module (VLPM)

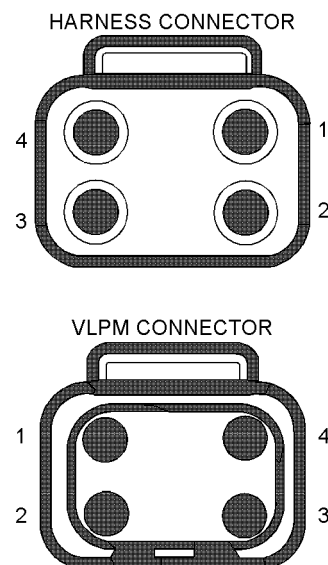


Illustration 100

g01313212

Pin locations on the VLPM connector

- Insert multimeter probes in pin 2 (Pump Battery +) of the VLPM connector and pin 3 (Pump Ground) of the VLPM connector.
- Connect a multimeter between the probes and ensure that the meter is set to zero.
- Turn the keyswitch to the ON position and measure the supply voltage to the VLPM.

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12.0 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24.0 Volt system.

Results:

- OK – The voltage is within limits. Proceed to Test Step 7.
- Not OK – The voltage is below the limits.

Repair: There is a fault in the VLPM.

Replace the VLPM.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

Test Step 8. Check the Power Circuit in the Pump Power Relay

- A.** Turn the keyswitch to the ON position.
- B.** Measure the voltage between the following points:
- Terminal A and the battery - terminal
 - Terminal B and the battery + terminal

Refer to Illustration 89 or 90.

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12.0 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24.0 Volt system.

Results:

- OK – The voltage is within limits. Proceed to Test Step 9.
- Not OK – The voltage is below limits between terminal A and the battery - terminal. There is a fault in the harness between the battery and the pump power relay.

Repair: Check the 30 amp fuse. Repair the harness or replace the harness.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

- Not OK – The voltage is below limits between terminal B and the battery - terminal. There is a fault in the harness between the pump power relay and the MIC.

Repair: Repair the harness, or replace the harness.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

Test Step 9. Check the Control Circuit in the Pump Power Relay

- A.** Turn the keyswitch to the ON position.
- B.** Measure the voltage between the following points:
- Terminal C and the battery - terminal
 - Terminal D and the battery + terminal

Refer to Illustration 89 or 90.

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12.0 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24.0 Volt system.

Results:

- OK – The voltage is within limits. Proceed to Test Step 10.
- Not OK – The voltage is below limits between terminal C and the battery - terminal. There is a fault in the harness between the battery and the pump power relay.

Repair: Check the 3 amp fuse. Repair the harness or replace the harness.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

- Not OK – The voltage is below limits between terminal D and the battery + terminal. There is a fault in the harness between the pump power relay and the ECM. Proceed to Test Step 10.

Test Step 10. Check the Supply Voltage at the Coil for the Pump Power Relay

- A.** Turn the keyswitch to the ON position.
- B.** Measure the voltage between terminal C and terminal D on the pump power relay.

- C. Turn the keyswitch to the OFF position and then turn the keyswitch to the ON position. The relay should emit a clicking sound as the keyswitch is turned to the ON position.
- D. Check that the voltage is present with the keyswitch in the ON position.
- E. Check that there is no voltage with the keyswitch in the OFF position.

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12.0 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24.0 Volt system.

Results:

- OK – The voltage is within limits. There is a fault in the relay.

Repair: Replace the relay.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

- Not OK – There is no voltage or the voltage is out of the acceptable range. Proceed to Test Step 11.

Test Step 11. Check the Pump Power Control Output from the ECM at the Machine Interface Connector

- A. Turn the keyswitch to the ON position.
- B. On applications with a 31 pin MIC, measure the voltage between the battery + terminal and terminal J20:3. Refer to Illustration 89.
- C. On applications with a 70 pin MIC, measure the voltage between the battery + terminal and terminal J20:42. Refer to Illustration 90.

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12.0 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24.0 Volt system.

Results:

- OK – The voltage is within limits. Proceed to Test Step 12.

- Not OK – There is a fault in wires between the relay and the MIC.

Repair: Repair the harness or replace the harness.

The voltage load protection module should also be replaced when the fuel injection pump is replaced.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

Test Step 12. Check the Pump Power Control Output at the ECM

- A. Turn the keyswitch to the ON position.
- B. Measure the voltage between the battery + terminal and terminal P1:42.
- C. Check that the voltage is present with the keyswitch in the ON position.
- D. Check that there is no voltage with the keyswitch in the OFF position.

Expected Result:

The battery voltage should be more than 11.0 Volts DC for a 12.0 Volt system.

The battery voltage should be more than 22.0 Volts DC for a 24.0 Volt system.

Results:

- OK – There is a fault in the harness between connector P1 and connector P20.

Repair: Repair the harness or replace the harness.

Use the electronic service tool to clear any logged diagnostic codes and verify that the repairs have eliminated the fault.

STOP.

- Not OK – There is a fault in the keyswitch input to the ECM.

Repair: Refer to Troubleshooting, "Electrical Power Supply Circuit - Test".

STOP.

i02622718

Indicator Lamp Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

- The lamps are not receiving battery voltage.
- The lamps are not operating correctly.

Also, use this procedure if another procedure has directed you here.

The following diagnostic lamps are available:

- Set speed lamp
- Warning lamp
- Engine shutdown lamp

The electronic service tool can be used as a diagnostic aid in order to switch the individual lamps ON and OFF.

Note: The diagnostic aid function that switches the lamps is contained in the “Override” section in the “Diagnostics” menu of the electronic service tool.

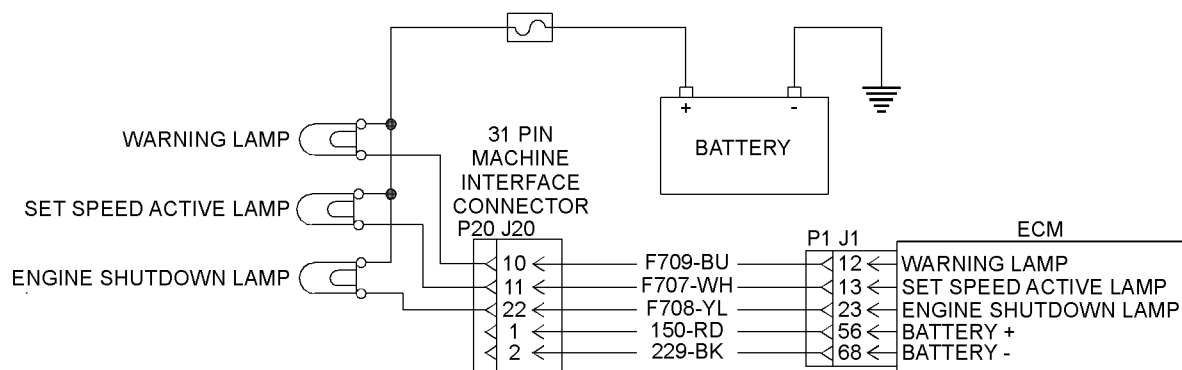


Illustration 101

Schematic diagram for the indicator lamps (31 pin Machine Interface Connector)

g01313354

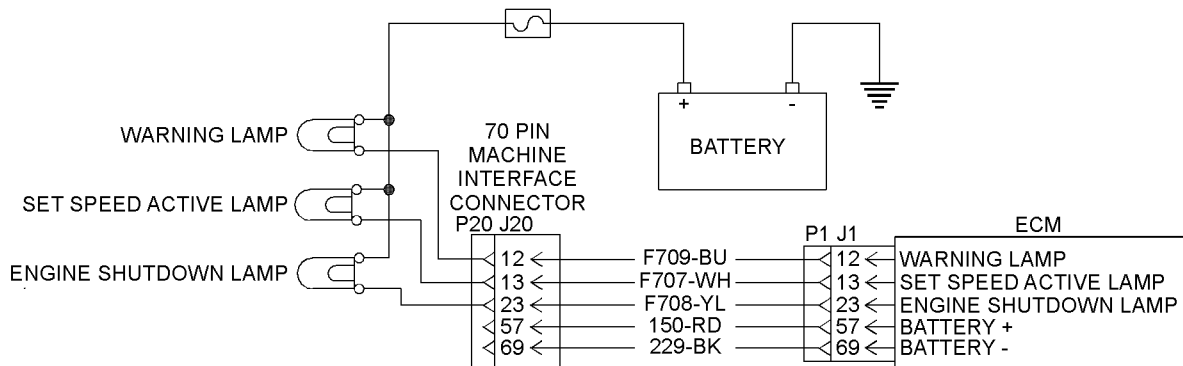
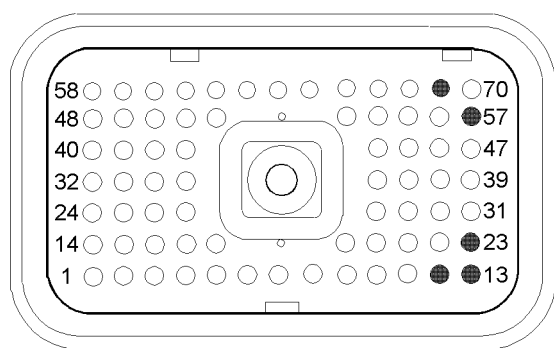


Illustration 102

g01313233

Schematic diagram for the indicator lamps (70 pin Machine Interface Connector)



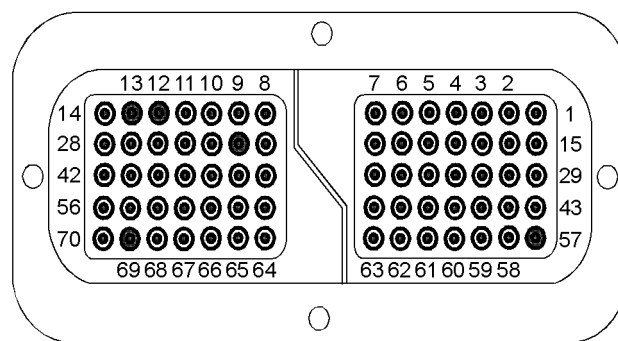
ECM Side

Illustration 103

g01313310

ECM pin locations for the indicator lamps

- (12) Warning lamp
- (13) Set speed active lamp
- (23) Engine shutdown lamp
- (56) Battery +
- (57) Battery +
- (68) Battery -
- (69) Battery -



70 Pin MIC (P20)

Illustration 105

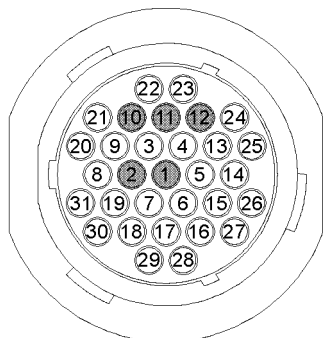
g01313294

Pin locations for the indicator lamps on the 70 pin Machine Interface Connector (MIC)

- (12) Warning lamp
- (13) Set speed active lamp
- (23) Engine shutdown lamp
- (57) Battery +
- (69) Battery -

Test Step 1. Inspect Electrical Connectors and Wiring

- A. Turn the keyswitch to the OFF position.
- B. Thoroughly inspect J1/P1 ECM connector, and the J20/P20 MIC. Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.
- C. Perform a 45 N (10 lb) pull test on each of the wires in the P20/J20 connector and the P1/J1 connector that are associated with the diagnostic lamps. Refer to illustration 102.
- D. Check the Allen head screw on the J1/P1 connector for the correct torque of 6.0 N·m (55 lb in).
- E. Check the harness for abrasions and for pinch points from the battery to the ECM.



31 Pin MIC (P20)

Illustration 104

g01313316

Pin locations for the indicator lamps on the 31 pin Machine Interface Connector (MIC)

- (1) Battery +
- (2) Battery -
- (10) Warning lamp
- (11) Set speed active lamp
- (12) Engine shutdown lamp

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly installed and ensure that the connectors are completely coupled.

Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

STOP.

Test Step 2. Inspect the Lamp, the Fuse, and the Power Supply

- A. Disconnect the lamp from the harness. Inspect the lamp in order to determine if the lamp has failed.
- B. Measure the resistance across the two terminals of the lamp. If the resistance is more than 2000 ohms, the bulb has failed.
- C. Check the battery by connecting a test lamp across the terminals of the battery.

Expected Result:

The lamp has less than 2000 ohms and the power supply is OK.

Results:

- OK – The lamp appears to be operating correctly at this time. Proceed to Test Step 3.
- Not OK

Repair: Replace the suspect component or repair the suspect component.

Use the electronic service tool to clear all logged diagnostic codes and verify that the repair eliminates the fault.

STOP.

Test Step 3. Measure the Input to the Lamp at the Lamp Socket

- A. Turn the keyswitch to the ON position.
- B. Use the electronic service tool to select the “override” function in order to switch individual lamps ON and OFF.

Note: The “Override” function is contained in the “Diagnostics” menu of the electronic service tool.

- C. Measure the voltage at the lamp socket.

Expected Result:

The voltage should be between 12.0 Volts DC and 24.0 Volts DC.

Results:

- OK – The voltage is between 12.0 Volts DC and 24.0 Volts DC.

Repair: Replace the bulb.

Verify that the repair eliminates the fault.

If the fault persists, measure the resistance across the 2 terminals of the lamp. If the resistance is more than 2000 ohms, the replacement bulb has failed. Replace the bulb and repeat the test.

If the fault persists, proceed to Test Step 4.

- Not OK – The voltage is not in the range that is expected. Proceed to Test Step 5.

Test Step 4. Test the Individual Lamp Circuits

- A. Disconnect ECM Connector J1/P1.
- B. Insert a 70-Pin Breakout T between ECM Connector J1 and ECM Connector P1.
- C. Fabricate a jumper wire 100 mm (4 inch) long. Crimp a Deutsch pin to both ends of the wire.
- D. Insert one end of the jumper wire into the socket for the driver for the suspect lamp.
- E. Insert the other end of the jumper wire into the socket for battery +.
- F. Turn the keyswitch to the ON position and observe the lamp.

Expected Result:

The diagnostic lamp turns on while the jumper is connected to both sockets. Also, the diagnostic lamp turns off when the jumper is removed from one of the sockets.

Results:

- OK – The circuit for the diagnostic lamp is functioning correctly. Proceed to Test Step 5.
- Not OK – The lamp did not turn on. The lamp circuit is not functioning correctly. There is a fault in the wiring between the lamp and the ECM.

Repair: Repair the lamp circuit.

Verify that the repair eliminated the fault.

STOP.

Test Step 5. Check the Voltage at the ECM

- A. Disconnect ECM Connector J1/P1.
- B. Insert a 70-Pin Breakout T between ECM Connector J1 and ECM Connector P1.
- C. Connect a voltage test lamp between J1:57 Battery + and J1:69 Battery -.
- D. On applications with a 31 pin MIC, connect a voltage test lamp to J1:56 Battery + and J1:12 Warning Lamp. Connect the voltage test lamp to J1:56 Battery + and J1:13 Set Speed Active Lamp. Connect the voltage test lamp to J1:56 Battery + and J1:23 Engine Shutdown Lamp.
- E. On applications with a 70 pin MIC, connect a voltage test lamp to J1:57 Battery + and J1:12 Warning Lamp. Connect the voltage test lamp to J1:57 Battery + and J1:13 Set Speed Active Lamp. Connect the voltage test lamp to J1:57 Battery + and J1:23 Engine Shutdown Lamp.

Expected Result:

The lamps should illuminate.

Results:

- OK – The ECM is operating correctly.

Repair: There is a fault in the wiring or one of the lamps.

1. Repair the wiring or the lamp, as required.

2. Verify that the repair eliminates the fault.

STOP.

- Not OK – The ECM may have a suspected fault.

Repair: Perform the following procedure:

1. Temporarily connect a test ECM.

Note: The test ECM must be programmed with the same parameters as the suspect ECM.

2. Check the operation of the diagnostic lamp when the test ECM is installed.

3. If the fault is resolved with the test ECM, then reconnect the suspect ECM.

- 4. If the fault returns with the suspect ECM, then replace the suspect ECM.

STOP.

i02623256

Mode Selection Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

- Diagnostic code 1743-02 is active.
- The switch cannot be switched to ground.
- The mode switch does not operate correctly.

Also, use this procedure if another procedure has directed you here.

The mode switch provides the operator with the ability to select a maximum of eight different modes of operation. Different modes of operation can be used in a particular situation by giving the operator a means to select the most efficient method of completing the required work. The following mode selections are available:

- Economy Mode
- Machine Mode
- Power Take-off Mode

Three digital switch inputs can be used in order to select the most efficient mode. With three switches, a maximum of eight modes can be applied by use of a multiple position switch.

With two switches, four modes can be selected.

With one switch, two modes can be selected.

Each mode has a single fuel limit map, a rated speed, and a matched fuel delivery. Each mode also has specific droop value for throttle 1 and throttle 2.

Test Step 1. Inspect Electrical Connectors and Wiring

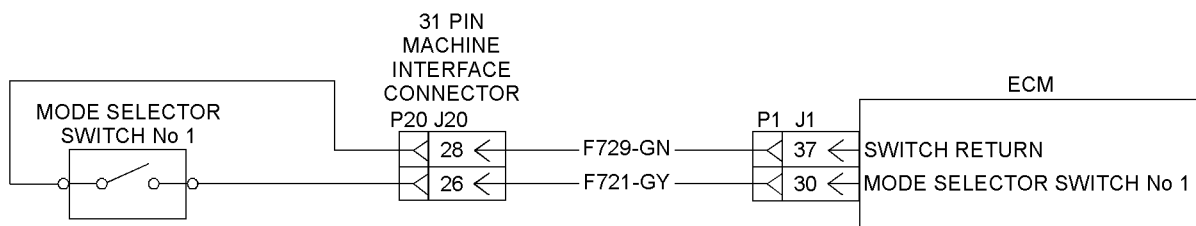


Illustration 106

g01313740

Schematic for the mode switch (31 pin MIC)

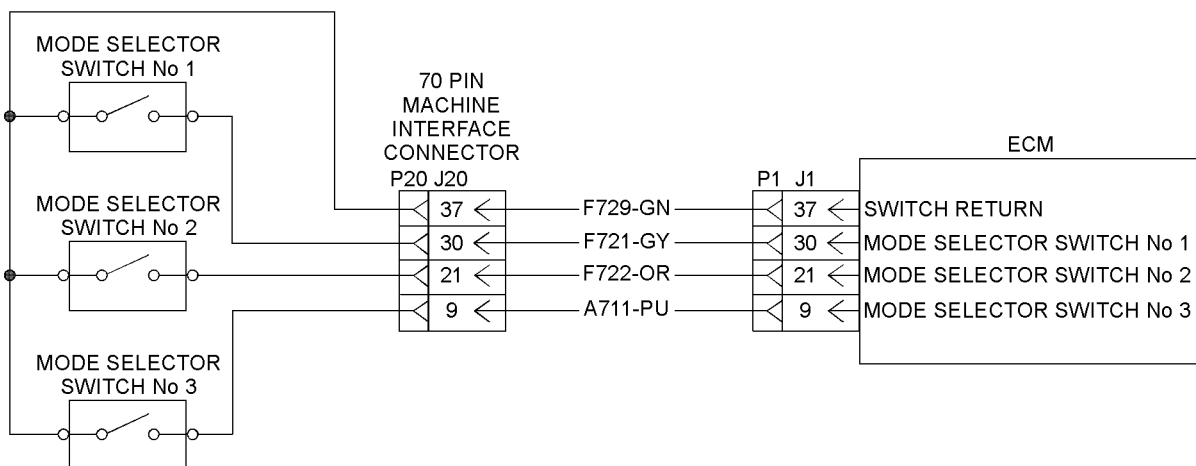
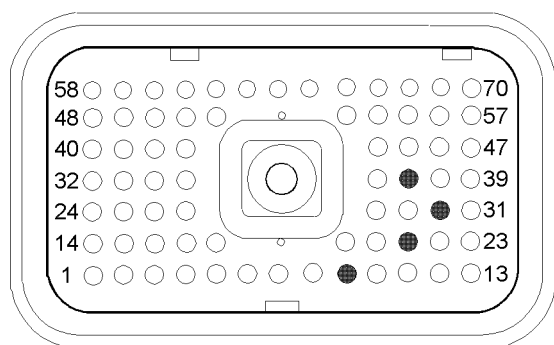


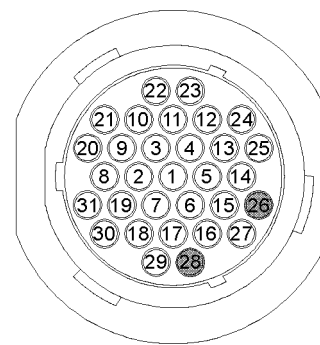
Illustration 107

g01313738

Schematic for the mode switches (70 pin MIC)



ECM Side



31 Pin MIC (P20)

Illustration 108

g01313744

ECM pin locations for the mode switches

- (9) Mode switch No. 3 (if equipped)
- (21) Mode switch No. 2 (if equipped)
- (30) Mode switch No. 1
- (37) Switch return

Illustration 109

g01313743

Pin locations for the mode switch (31 pin MIC)

- (26) Mode switch No. 1
- (28) Switch return

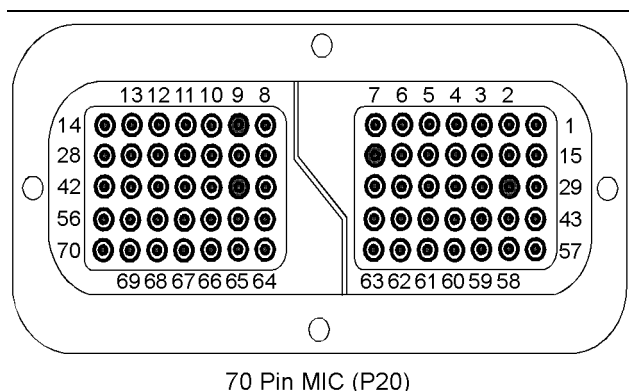


Illustration 110

g01313747

Pin locations for the mode switches (70 pin MIC)

- (9) Mode switch No. 3
- (21) Mode switch No. 2
- (30) Mode switch No. 1
- (37) Switch return

- A. Turn the keyswitch OFF.
- B. Thoroughly inspect J1/P1 ECM connector and the J20/P20 MIC. Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.
- C. Perform a 45 N (10 lb) pull test on each of the wires in the P1/J1 ECM connector and the P20/J20 MIC that are associated with the mode switch. Refer to illustration 106 or 107.
- D. Check the Allen head screw on the J1/P1 ECM connector for the correct torque of 6.0 N·m (55 lb in).
- E. Check the harness and wiring for abrasions and for pinch points from the battery to the ECM.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair the connectors or wiring and/or replace the connectors or wiring. Ensure that all of the seals are correctly installed and ensure that the connectors are completely coupled.

Verify that the repair eliminates the fault.

STOP.

- – If the fault has not been eliminated, proceed to Test Step 2.

Test Step 2. Check the Mode Selector Switch

- A. Turn the keyswitch to the OFF position.

- B. Disconnect the harness connector from the mode selector switch.
- C. Install a jumper wire between the suspect terminal on the mode selector switch and the terminal for the switch return.
- D. Turn the keyswitch to the ON position.
- E. Monitor the status screen on the electronic service tool.
- F. Slowly disconnect the jumper wire and then reconnect the jumper wire on the suspect terminal on the mode selector switch.

Expected Result:

When the jumper wire is disconnected, the switch should be in the OPEN position.

When the jumper wire is connected, the switch should be in the CLOSED position.

Results:

- OK – When the jumper wire is disconnected, the status of the switch changes from "CLOSED" to "OPEN".

Repair: Replace the faulty mode selector switch.

Use the electronic service tool to clear any logged diagnostic codes and verify that the fault has been eliminated.

STOP.

- Not OK – When the jumper wire is disconnected, the status of the mode selector switch does not change. Proceed to Test Step 3.

Test Step 3. Insert a Jumper at the Suspect Mode Switch

- A. Turn the keyswitch to the OFF position. Disconnect the suspect mode switch.
- B. Perform the following procedure to test the circuit of Mode Switch No. 1. Insert the jumper wire between P20:30 and P20:37.
- C. If the installation has a 70 pin MIC, perform the following procedure to test the circuit of Mode Switch No. 2. Insert a jumper wire between P20:21 and P20:37.
- D. If the installation has a 70 pin MIC, perform the following procedure to test the circuit of Mode Switch No. 3. Insert a jumper wire between P20:9 and P20:37.

- E. Turn the keyswitch to the ON position. Monitor the status screen on the electronic service tool. Slowly connect and disconnect each jumper wire.

Expected Result:

When the jumper wire is disconnected the switch should be in the OPEN position. When the jumper wire is connected the switch should be in the CLOSED position.

Results:

- OK

Repair: Verify that the jumper wire has been removed. The suspect mode switch is faulty. Replace the switch and verify that the repair has eliminated the fault.

STOP.

- Not OK – Proceed to Test Step 4.

Test Step 4. Measure the Resistance at the P20/J20 MIC

- A. Turn the keyswitch to the OFF position.
- B. Reconnect the suspect switch.
- C. Disconnect the P20 connector from the J20 MIC.
- D. Measure the resistance between P20:37 switch return and the following MIC pins:
- P20:30 Switch No. 1
 - P20:21 Switch No. 2 (if equipped)
 - P20:9 Switch No. 3 (if equipped)

Expected Result:

The switch measures less than 10 ohms in the ON position.

The switch measures more than 2000 ohms in the OFF position.

Results:

- OK – Proceed to Test Step 5.
- Not OK – The fault is in the wires between the switch and the MIC.

Repair: Repair the connector or replace the connector. Verify that the repair has eliminated the fault.

Repeat Test Step 3 if the problem has not been eliminated.

Test Step 5. Measure the Resistance of the Wire Harness at the ECM

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P1 connector from the ECM connector.
- C. Measure the resistance between P1:37 switch return and the following ECM pins:
- P1:30 Switch No. 1
 - P1:21 Switch No. 2 (if equipped)
 - P1:9 Switch No. 3 (if equipped)
- D. Cycle the switch to the OFF position and to the ON position.

Expected Result:

The switch measures less than 10 ohms in the ON position.

The switch measures more than 2000 ohms in the OFF position.

Results:

- OK – There is not a fault in the wire or the wire harness. Proceed to Test Step 6.
- Not OK – The fault is in the wire harness between the MIC and the ECM connector.

Repair: Repair the connector or replace the connector. Verify that the repair has eliminated the fault.

Proceed to Test Step 6 if the fault has not been eliminated.

Test Step 6. Test the ECM

- A. Turn the keyswitch to the OFF position.
- B. Disconnect the P1 connector from the J1 ECM connector. Connect a 70 pin Breakout T between the ECM connector J1 and ECM connector P1.
- C. Measure the resistance between P1:37 switch return and the following MIC pins:
- P1:30 Switch No. 1
 - P1:21 Switch No. 2 (if equipped)
 - P1:9 Switch No. 3 (if equipped)
- D. Insert a jumper wire between the suspect switch socket in the 70 pin Breakout T and the socket 37 of the Breakout T.

- E. Turn the keyswitch to the ON position. Monitor the status screen on the electronic service tool. Slowly connect and disconnect the jumper wire from the 70 pin Breakout T.

Expected Result:

With the switch in the OFF position, the switch will have an open condition.

With the switch in the ON position, the switch will have a closed condition.

Results:

- OK – The ECM is operating correctly. STOP.
- Not OK – There is a suspected fault in the ECM.

Repair: If the fault has not been eliminated, temporarily connect a test ECM. Remove all jumpers and replace all connectors. The test ECM should be programmed with the correct software. All parameters should be set to the same value of the suspect ECM.

If the fault is eliminated with the test ECM, reconnect the suspect ECM. If the fault returns with the suspect ECM, replace the suspect ECM.

Verify that the repair has eliminated the fault.

STOP.

- Single speed
- Dual Speed
- No speed (no set speed control)

The set speed switches are listed below:

- P1:28 Set Speed Control ON or OFF
- P1:11 Set Speed Continue or Accelerate
- P1:19 Set Speed 1 or Set Speed 2
- P1:20 Set Speed Set or Decelerate
- P1:29 Clutch or Brake Automatic Disengage

Warning lamps are used to indicate the status of the set speed control.

i02623330

Set Speed Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

- The set speed switches are not receiving the correct supply voltage.
- The set speed switches are not operating correctly.

Also, use this procedure if another procedure has directed you here.

The set speed switches provides the operator with the ability to select the desired engine speed. Engine speed will decrease with increasing load. The set speed control can be used to control the engine speed. Also for certain engine applications, the set speed control can be used to control the vehicle speed.

The 1104 and 1106 engines have the following options of set speed control:

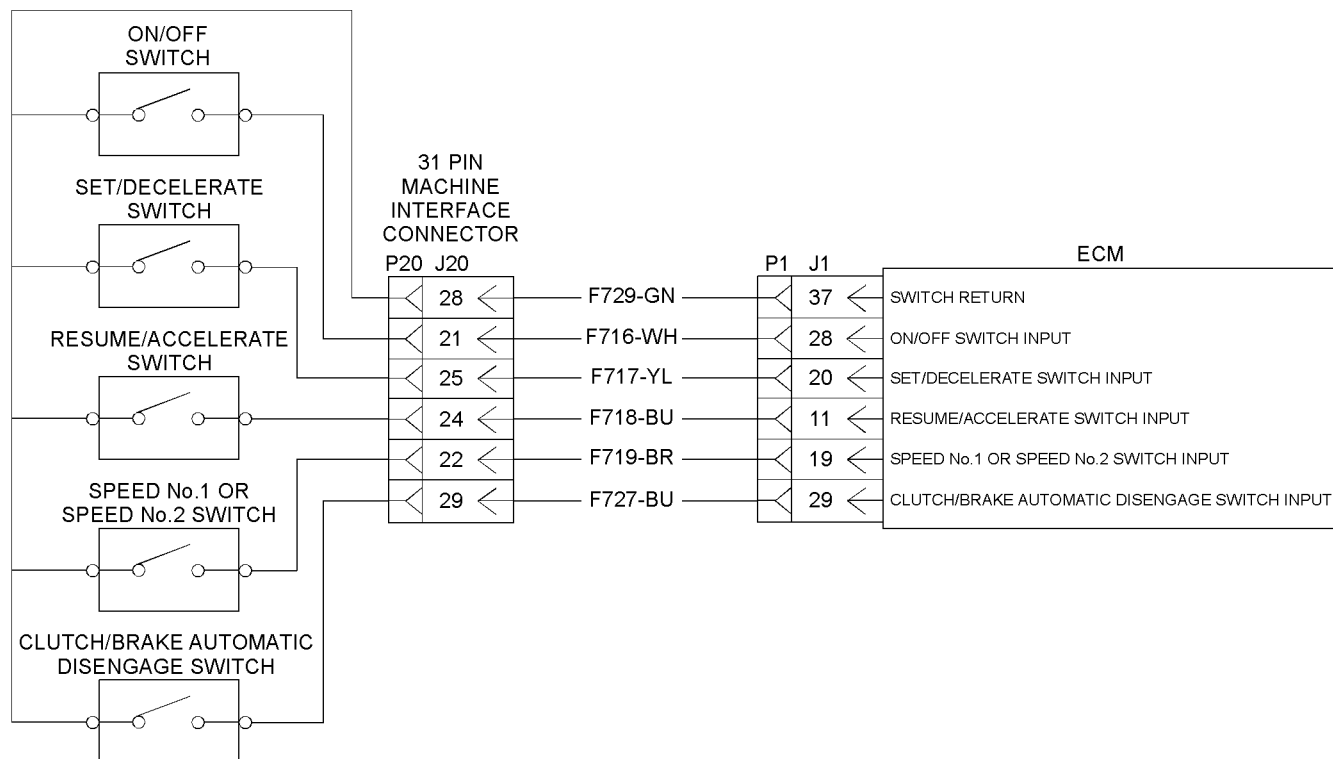


Illustration 111

g01313939

Schematic for the set speed switches with a 31 pin MIC

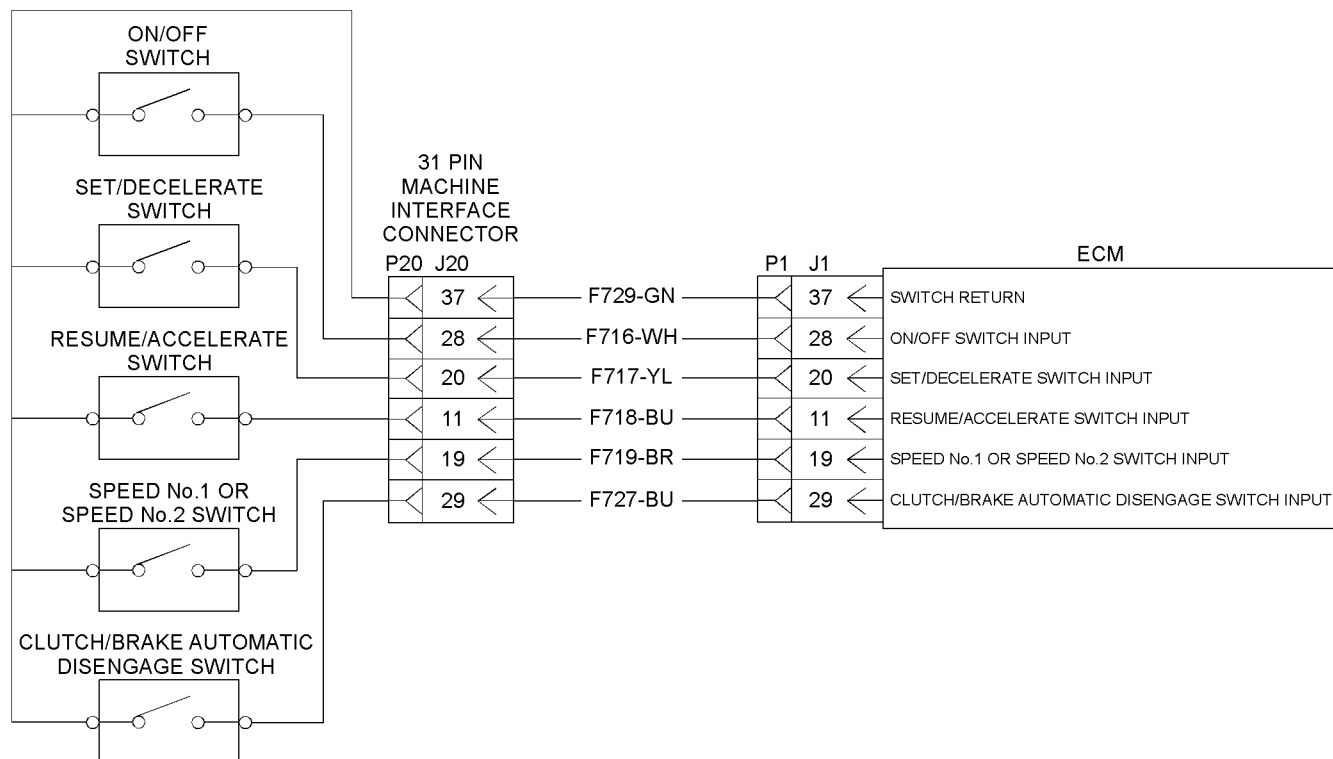
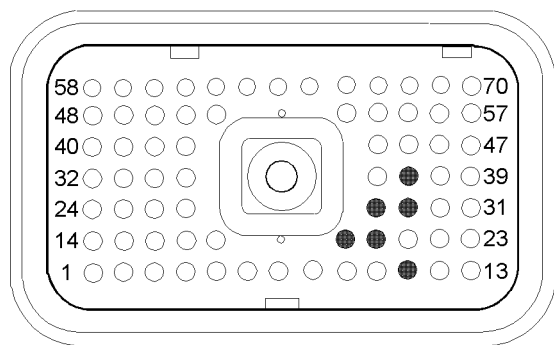


Illustration 112

g01322347

Schematic for the set speed switches with a 70 pin MIC



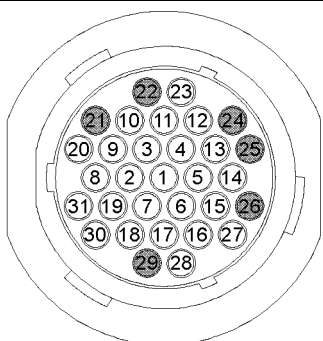
ECM Side

Illustration 113

g01313945

Pin locations on the ECM connector

- (11) Resume/Accelerate Switch
- (19) Speed No.1 or Speed No.2 Switch
- (20) Set/Decelerate Switch
- (28) On/Off Switch
- (29) Clutch/Brake Automatic Disengage Switch
- (37) Switch Return



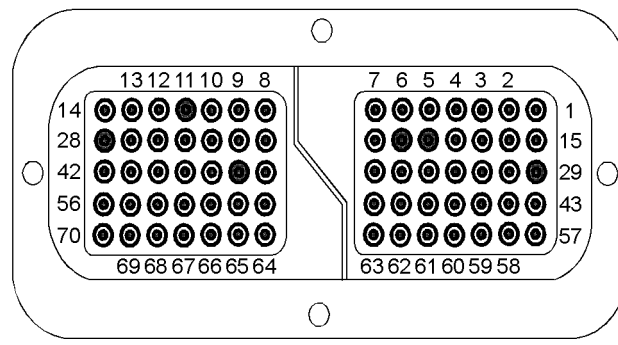
31 Pin MIC (P20)

Illustration 114

g01313955

Pin locations on the 31 pin MIC

- (21) On/Off Switch
- (22) Speed No.1 or Speed No.2 Switch
- (24) Resume/Accelerate Switch
- (25) Set/Decelerate Switch
- (26) Switch Return
- (29) Clutch/Brake Automatic Disengage Switch



70 Pin MIC (P20)

Illustration 115

g01313966

Pin locations on the 70 pin MIC

- (11) Resume/Accelerate Switch
- (19) Speed No.1 or Speed No.2 Switch
- (20) Set/Decelerate Switch
- (28) On/Off Switch
- (29) Clutch/Brake Automatic Disengage Switch
- (37) Switch Return

Test Step 1. Inspect Electrical Connectors and Wiring

- A. Turn the keyswitch to the OFF position.
- B. Thoroughly inspect ECM connector J1/P1, Machine Interface Connector (MIC) J20/P20, and the battery connections. Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.
- C. Check the harness and wiring for corrosion, abrasion, and pinch points from the throttle switch to the ECM.

Expected Result:

All connectors, pins, and sockets should be completely inserted and coupled. The harness and wiring should be free of corrosion, abrasion, and pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair the circuit.

Verify that the repair eliminates the fault.

STOP.

Test Step 2. Check "Set Speed Switch" on the Electronic Service Tool

- A. Turn the keyswitch to the OFF position.
- B. Connect the electronic service tool to the diagnostic connector.

- C. Turn the keyswitch to the ON position.
- D. Observe the status of the set speed switch on the electronic service tool while you operate the set speed switch from the speed 1 position to the speed 2 position.
- E. Observe the status of the set speed switch on the electronic service tool while you operate the set speed switch from the ON position to the OFF position.
- F. Observe the status of the set speed switch while you operate the set speed/decelerate switch from the OFF position to the ON position.
- G. Observe the status of the set speed control resume or accelerate switch while you operate the switch from the OFF position to the ON position.

Expected Result:

Result 1 the electronic service tool should show that the speed 1 status is selected with the set speed switch in the OFF position.

The electronic service tool should show that the speed 2 status is selected with the set speed switch in the ON position.

Note: If the engine application has two engine speed controls, ensure that speed 1 is selected.

Result 2 The electronic service tool should show that the set speed control switch is in the "OPEN" condition when the set speed control switch is in the OFF position.

The electronic service tool should show that the set speed switch is in the "CLOSED" position when the set speed switch is in the ON position.

Note: The set speed control lamp should be OFF when the set speed control switch is in the OFF position. The set speed control lamp should be flashing when the set speed control switch is in the ON position.

Result 3 When the set speed switch is in the OFF position, the set speed/decelerate switch should be in the OPEN position.

When the set speed/decelerate switch is in the ON position, the set speed/decelerate switch should be in the CLOSED position.

Result 4 When the set speed control resume or accelerate switch is in the OFF position, the display screen should show an OPEN condition.

When the set speed control resume or accelerate switch is in the ON position, the display screen should show a CLOSED condition.

Note: The set speed control lamp 1 should change from flashing to ON when the set speed resume or accelerate switch is CLOSED.

Results:

- OK – The set speed control switches operate correctly. STOP.
- Not OK – Proceed to Test Step 3.

Test Step 3. Check the Status of the Automatic Set Speed Disengage Switch

A. Disconnect the P1/J1 ECM connector.

B. Insert a 70 pin Breakout T between P1 and J1.

C. Measure the voltage between the following pin locations:

- P1:29
- P1:37

D. Use the electronic service tool to observe the voltage while the Automatic Set Speed Disengage Switch is operated OFF and ON.

Expected Result:

The electronic service tool will show that the status of the automatic set speed disengage switch is in the "ENGAGED" position. The voltage should be between 0 Volts and 0.8 Volts.

The electronic service tool will show that the status of the automatic set speed disengage switch is in the "DISENGAGED" position. The voltage should be between 12.3 Volts and 12.9 Volts.

Results:

- OK – The set speed disengage switch operates correctly. STOP.
- Not OK – Proceed to Test Step 4.

Test Step 4. Check the Speed Control Switch

A. Turn the keyswitch to the OFF position.

B. Remove the two wires from the set speed control switch. Use a suitable jumper in order to join the two wires together.

C. Turn the keyswitch to the ON position.

D. Monitor the status screen on the electronic service tool. Slowly connect and disconnect the jumper from the connector for the switch.

Expected Result:

When the jumper wire is connected the status of the set speed switch should be "CLOSED".

When the jumper wire is disconnected the status of the set speed switch should be "OPEN".

Results:

- OK – The switch is faulty.

Repair: Replace the suspect switch. Refer to the documentation for the application.

Use the electronic service tool to clear all logged diagnostic codes.

Verify that the repair has eliminated the fault.

STOP.

- Not OK – There is a fault in the wiring harness between the set speed control switch and the engine ECM. Proceed to Test Step 5.

Test Step 5. Measure the Resistance of the Cables Between the Machine Interface Connector (MIC) and the ECM Connector

- Turn the keyswitch to the OFF position.
- Connect the wires to any disconnected switch.
- Disconnect the J1/P1 ECM connector.
- Disconnect the J20/P20 MIC connector.
- On applications with a 31 pin MIC, measure the resistance between the following pairs of pins:
 - P1:11 and P20:24 Set speed control resume/accelerate
 - P1:19 and P20:22 Set speed control speed 1 or speed 2
 - P1:20 and P20:25 Set speed control set or decelerate
 - P1:28 and P20:21 Set speed control
 - P1:29 and P20:29 Set speed control clutch or brake disengage
 - P1:37 and P20:28 Set speed control clutch or brake disengage
- On applications with a 70 pin MIC, measure the resistance between the following pairs of pins:

- P1:11 and P20:11 Set speed control resume/accelerate
- P1:19 and P20:19 Set speed control speed 1 or speed 2
- P1:20 and P20:20 Set speed control set or decelerate
- P1:28 and P20:28 Set speed control
- P1:29 and P20:29 Set speed control clutch or brake disengage
- P1:37 and P20:37 Set speed control clutch or brake disengage

Expected Result:

With the switch in the ON position, the measured resistance should be less than 10 ohms.

With the switch in the OFF position, the measured resistance should be more than 20000 ohms.

Results:

- OK – Proceed to Test Step 6.
- Not OK – There is a fault in a wire between the P1 connector and the P20 connector.

Repair: Repair the wires or replace the wires.

Use the electronic service tool to clear all logged diagnostic codes.

Verify that the repair has eliminated the fault.

STOP.

Test Step 6. Test the Engine ECM

- Turn the keyswitch to the OFF position.
- Insert a 70 pin Breakout T between the P1 connector and P2 connector.
- Insert one end of a jumper wire into the socket for the suspect switch. Insert the other end of the jumper wire into P1:37 switch return.
- Turn the keyswitch to the ON position and monitor the status screen on the electronic service tool. Slowly connect and disconnect the jumper wire from the socket of pin 37 of the Breakout T.

Expected Result:

The status screen should display an OPEN condition with the switch in the OFF position.

The status screen should display a CLOSED condition with the switch in the ON position.

Results:

- OK – The ECM is working correctly.
STOP.
- Not OK – The ECM is not working correctly.

Repair: Temporarily connect a test ECM.

The test ECM should be programmed with the correct software. All parameters should be set to the same values as the suspect ECM.

If the fault is eliminated with the test ECM, reconnect the suspect ECM.

If the fault returns with the suspect ECM, then the suspect ECM is faulty.

Replace the suspect ECM.

Use the electronic service tool to clear all logged diagnostic codes.

Verify that the repair has eliminated the fault.

STOP.

i02636975

Speed/Timing Sensor Circuit - Test

System Operation Description:

Use this procedure if another procedure has directed you here.

Use this procedure if one of the following diagnostic codes is active or logged:

- 0320-02 Primary Speed/Timing Sensor – erratic, intermittent, or incorrect
- 0320-11 Primary Speed/Timing Sensor – mechanical failure

The engine has two speed/timing sensors. The engine (primary) speed/timing sensor is located on the left hand side of the cylinder block, close to the flywheel housing. The fuel pump (secondary) speed/timing sensor is an integral part of the fuel pump, which is mechanically connected to the camshaft.

In order to diagnose faults with the speed/timing sensor in the fuel pump, refer to Troubleshooting, “CAN Data Link Circuit - Test”.

The engine speed/timing sensor generates a signal by detecting the gap in the wheel of the crankshaft timing ring. The signal is then transmitted to the ECM and is used to give a reference point which allows the ECM to know the position of the crankshaft and the speed of the engine by measurement of the time between signal pulses.

During normal operation, the loss of the signal from the engine speed/timing sensor will cause the engine to operate in limp home mode.

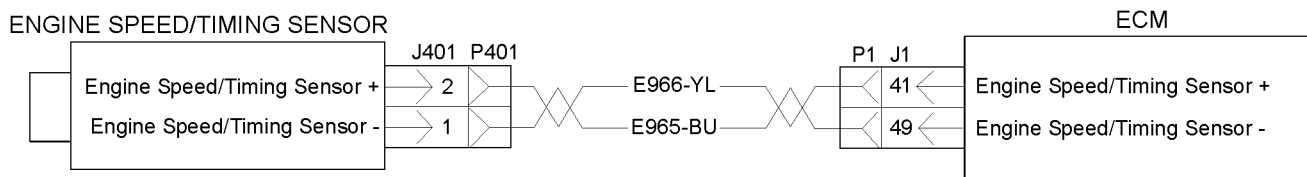


Illustration 116

g01311831

The schematic for the engine speed/timing sensor

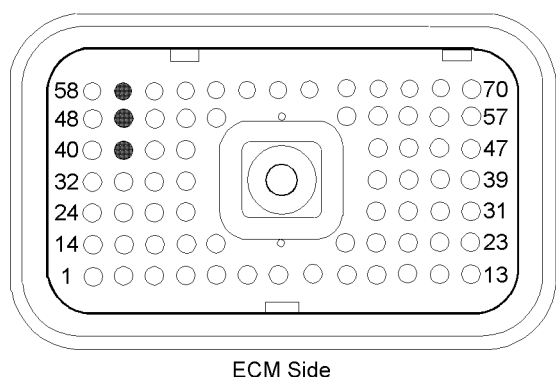


Illustration 117

g01322265

Pin locations on the P1 ECM connector

- (41) Engine speed/timing sensor +
- (49) Engine speed/timing sensor -
- (59) Engine position

Test Step 1. Inspect the Electrical Connectors and the Harness

- A. Turn the keyswitch to the OFF position.
- B. Inspect the following electrical connectors for these conditions: damage, abrasions, corrosion, and incorrect attachment. Refer to Troubleshooting, "Electrical Connectors - Inspect".
 - P1/J1 ECM connector
 - P401/J401 Connector for the engine speed/timing sensor
- C. Perform a 45 N (10 lb) pull test on each of the wires in the ECM connector and the sensor connectors that are associated with the active diagnostic code.
- D. Check the ECM connector (Allen head screw) for the correct torque of 6.0 N·m (55 lb in).

- E. Check the harness and wiring for abrasions and for pinch points from the sensors to the ECM.
- F. Check that the engine speed/timing sensor is correctly installed and that the sensor is fully seated against the cylinder block.
- G. Perform a "Wiggle Test" by using the electronic service tool in order to identify intermittent connections. Refer to Troubleshooting, "Electrical Connectors - Inspect".

Expected Result:

All connectors, pins, and sockets should be completely coupled and inserted. The harness should be free of corrosion, abrasion, and pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair the connectors or the harness and/or replace the connectors or the harness. Ensure that all of the seals are correctly installed and ensure that the connectors are completely coupled.

Use the electronic service tool to clear all logged diagnostic codes.

Verify that the repair eliminates the fault.

STOP.

Test Step 2. Measure the Sensor Resistance Through the Wiring Harness

- A. Turn the keyswitch to the OFF position.
- B. Remove the P1 ECM connector.

- C. Use a multimeter to measure the resistance of the sensor from P1:41 to P1:49.
- D. Wiggle the cables that are associated with the engine speed/timing sensor while the resistance is measured in order to check for an intermittent open or short circuit.

Refer to Illustration 116.

- E. The resistance between the terminals should be from 75 to 230 ohms.

Expected Result:

The resistance value is between 75 ohms and 230 ohms.

Results:

- OK – Neither a short circuit nor an open circuit is indicated. Proceed to Test Step 4.
- Not OK – The resistance is not within the acceptable range when the circuit resistance is measured through the engine harness. Proceed to Test Step 3.

Test Step 3. Measure the Resistance of the Sensor

- A. Turn the keyswitch to the OFF position.
- B. Check the harness and the wiring for abrasion and pinch points from the sensor to the ECM.
- C. Disconnect P401 engine speed/timing sensor connector.
- D. Thoroughly inspect the J401/P401 engine speed/timing sensor connector. Refer to Troubleshooting, “Electrical Connectors - Inspect”.
- E. The resistance between the terminals should be from 75 to 230 ohms.

Expected Result:

The resistance value is between 75 ohms and 230 ohms.

Results:

- OK – The sensor resistance is within tolerance.

Repair: There is a fault in the cable between the P1 ECM connector and the P401 connector.

Proceed to Test Step 5.

- Not OK – The sensor resistance is out of the nominal range. Proceed to Test Step 4.

Test Step 4. Check the Installation of the Engine Speed/Timing Sensors

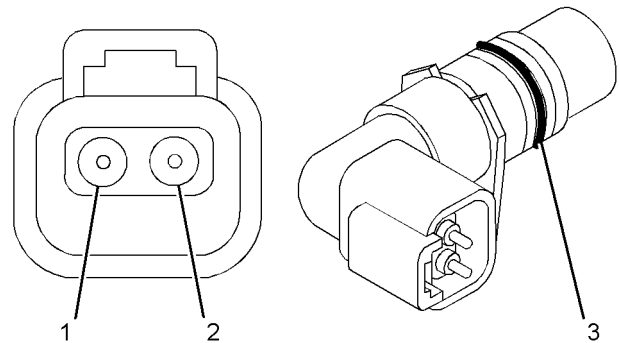


Illustration 118

g01322542

Speed/timing sensor

- (1) Engine speed/timing sensor -
- (2) Engine speed/timing sensor +
- (3) O ring seal

- A. Turn the keyswitch to the OFF position.
- B. Refer to Troubleshooting, “Electrical Connectors - Inspect”.
- C. For correct operation, ensure that the metal plate of the engine speed/timing sensor is installed flat against the cylinder block.
- D. Check that “O” ring (3) has been installed correctly on the sensor and that the “O” ring is not damaged.

Expected Result:

Check that the electrical connectors and the cables are correctly installed.

Results:

- OK – The electrical connectors and the cables are correctly installed. Proceed to Test Step 5.
- Not OK

Repair: In order to correctly install the engine speed/timing sensor, complete all of the following tasks:

- Lubricate the “O” ring with clean engine lubricating oil.
- Ensure that the sensor has a seal inside the connector body. If a seal is damaged or missing, replace the seal.
- Ensure that the sensor is fully seated into the engine before tightening the bracket bolt.
- Ensure that the connector is latched on both sides.

- Ensure that the harness is correctly secured, and ensure that the harness is attached to the harness clip.

Use the electronic service tool to clear all logged diagnostic codes.

Verify that the repair has eliminated the fault.

STOP.

Test Step 5. Measure the Resistance of the Cables Between the Fuel Injection Pump and the ECM

- A.** Turn the keyswitch to the OFF position.
- B.** Disconnect the P1 ECM connector and the P40 fuel injection pump connector.
- C.** Measure the resistance from P1:59 to P40:8.
- D.** The resistance should be less than 2 ohms.

Expected Result:

The readings agree with the values that are listed above.

Results:

- OK – The ECM does not operate correctly.

Repair: Perform the following repairs on the suspect ECM.

1. Temporarily install a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value as the suspect ECM.

2. If the fault is eliminated with the test ECM, reconnect the suspect ECM.
3. If the fault returns with the suspect ECM, then the suspect ECM is faulty. Replace the suspect ECM.

STOP.

- Not OK – The readings are higher than 2 ohms. Proceed to Test Step 6.

Test Step 6. Check the Continuity of the Cables From the ECM to the Fuel Injection Pump

- A.** Turn the keyswitch to the OFF position.
- B.** Disconnect the J1/P1 ECM connector and the J40/P40 fuel injection pump connector.

- C.** Perform a continuity test between P40:8 and the following terminals:

- P40:1
- P40:2
- P40:5
- P40:6
- P40:7

Expected Result:

The continuity check is positive.

Results:

- OK – There is a fault with the cables between the fuel injection pump and/or the ECM.

Repair: Replace the cable.

Use the electronic service tool to clear all logged diagnostic codes.

Verify that the repair eliminates the fault.

STOP.

- Not OK – The ECM is suspect.

Repair: Perform the following procedure:

1. Temporarily install a test ECM.

Note: The test ECM should be programmed with the correct software. All parameters should be set to the same value as the suspect ECM.

2. If the fault is eliminated with the test ECM, reconnect the suspect ECM.
3. If the fault returns with the suspect ECM, then the suspect ECM is faulty.
4. Replace the suspect ECM.

STOP.

i02623821

Throttle Switch Circuit - Test

System Operation Description:

Use this procedure under the following circumstances:

- Throttle switch inputs cannot be switched to ground.

- Verification of the throttle switch is required.

Also, use this procedure if another procedure has directed you here.

The throttle switch provides the operator with the ability to select the desired engine speed. Engine speed will decrease with increasing load. The throttle switch is a rotary switch with ten positions.

The throttle switch is connected to the four throttle inputs of the Electronic Control Module (ECM). Each position generates a specific on/off pattern on the throttle inputs. A diagnostic code is generated if a pattern that does not correspond with any of the switch positions is detected.

Once a diagnostic code is generated, the ECM ignores the throttle input signals and desired engine speed is set to the last valid pattern that was recognized by the ECM. Desired engine speed is set to low idle while the engine is not running.

Voltage at the throttle inputs to the ECM should be 11.5 ± 0.5 Volts DC when the throttle inputs are open. The voltage should be less than 0.5 Volts DC when the throttle inputs are closed.

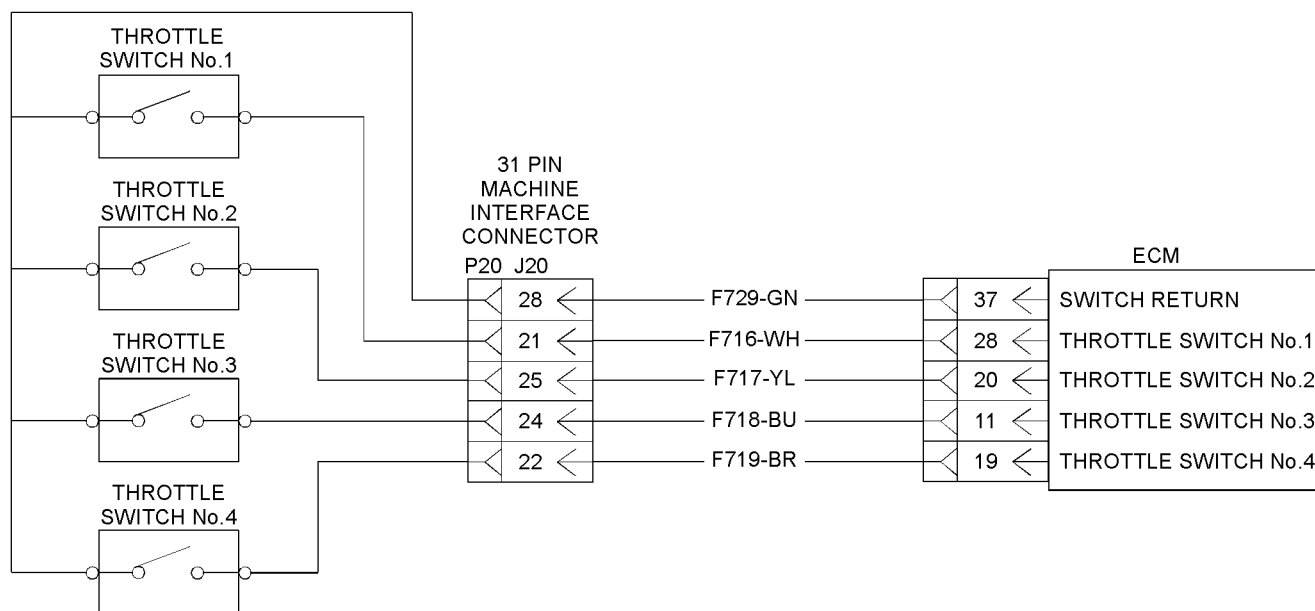


Illustration 119

g01314464

Schematic diagram for the throttle switches (31 pin MIC)

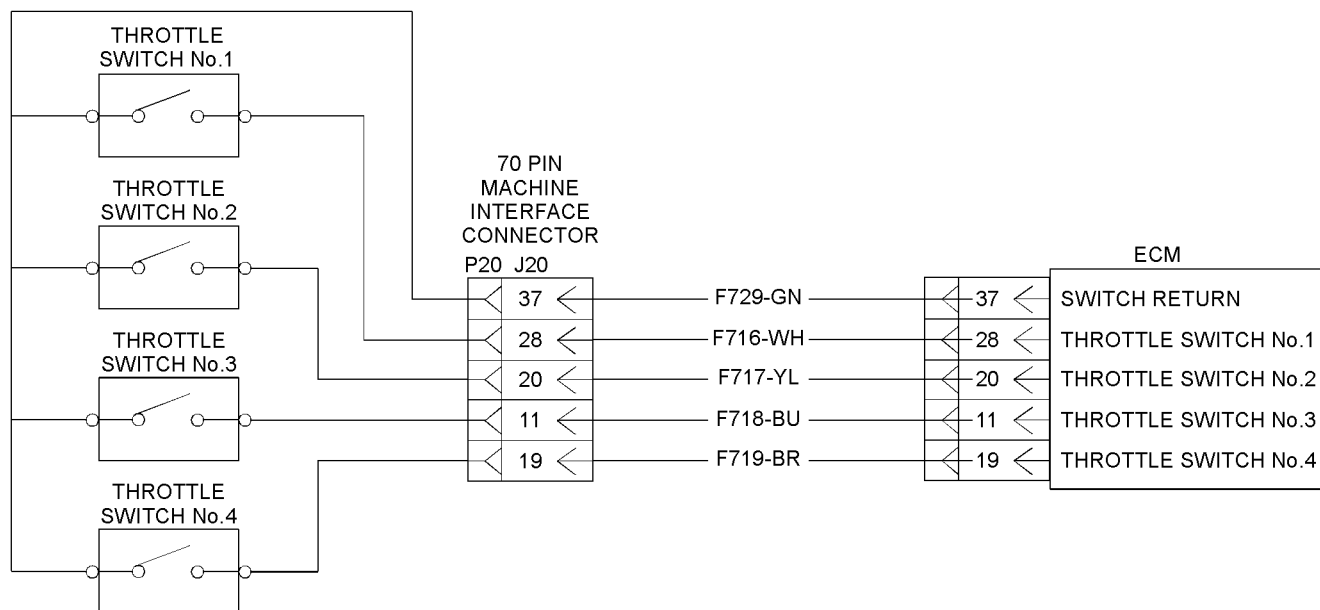
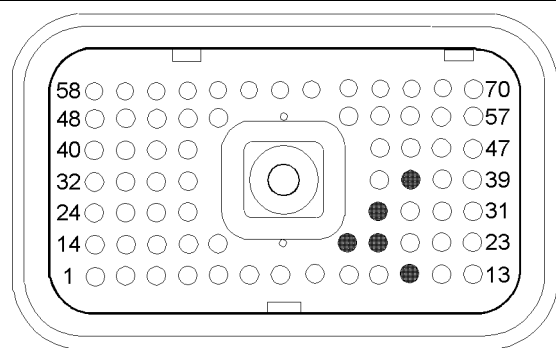


Illustration 120

g01314473

Schematic diagram for the throttle switches (70 pin MIC)



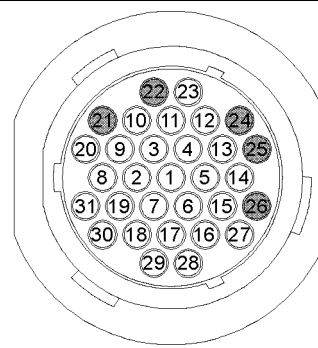
ECM Side

Illustration 121

g01314517

Pin locations on the ECM connector

- (11) Throttle Switch No.3
- (19) Throttle Switch No.4
- (20) Throttle Switch No.2
- (28) Throttle Switch No.1
- (37) Switch Return



31 Pin MIC (P20)

Illustration 122

g01314462

Pin locations on the 31 pin MIC

- (21) Throttle Switch No.1
- (22) Throttle Switch No.4
- (24) Throttle Switch No.3
- (25) Throttle Switch No.2
- (28) Switch Return

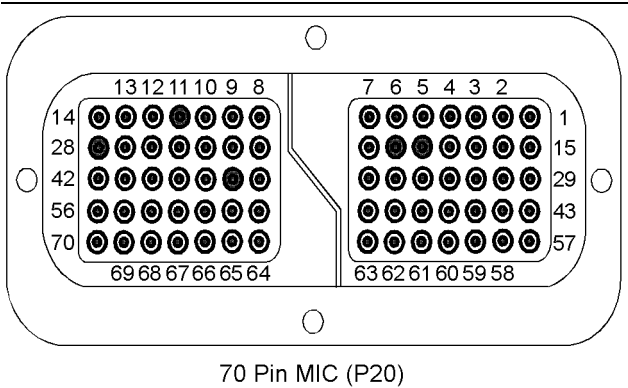


Illustration 123
g01314526

Pin locations on the 70 pin MIC

- (11) Throttle Switch No.3
- (19) Throttle Switch No.4
- (20) Throttle Switch No.2
- (28) Throttle Switch No.1
- (37) Switch Return

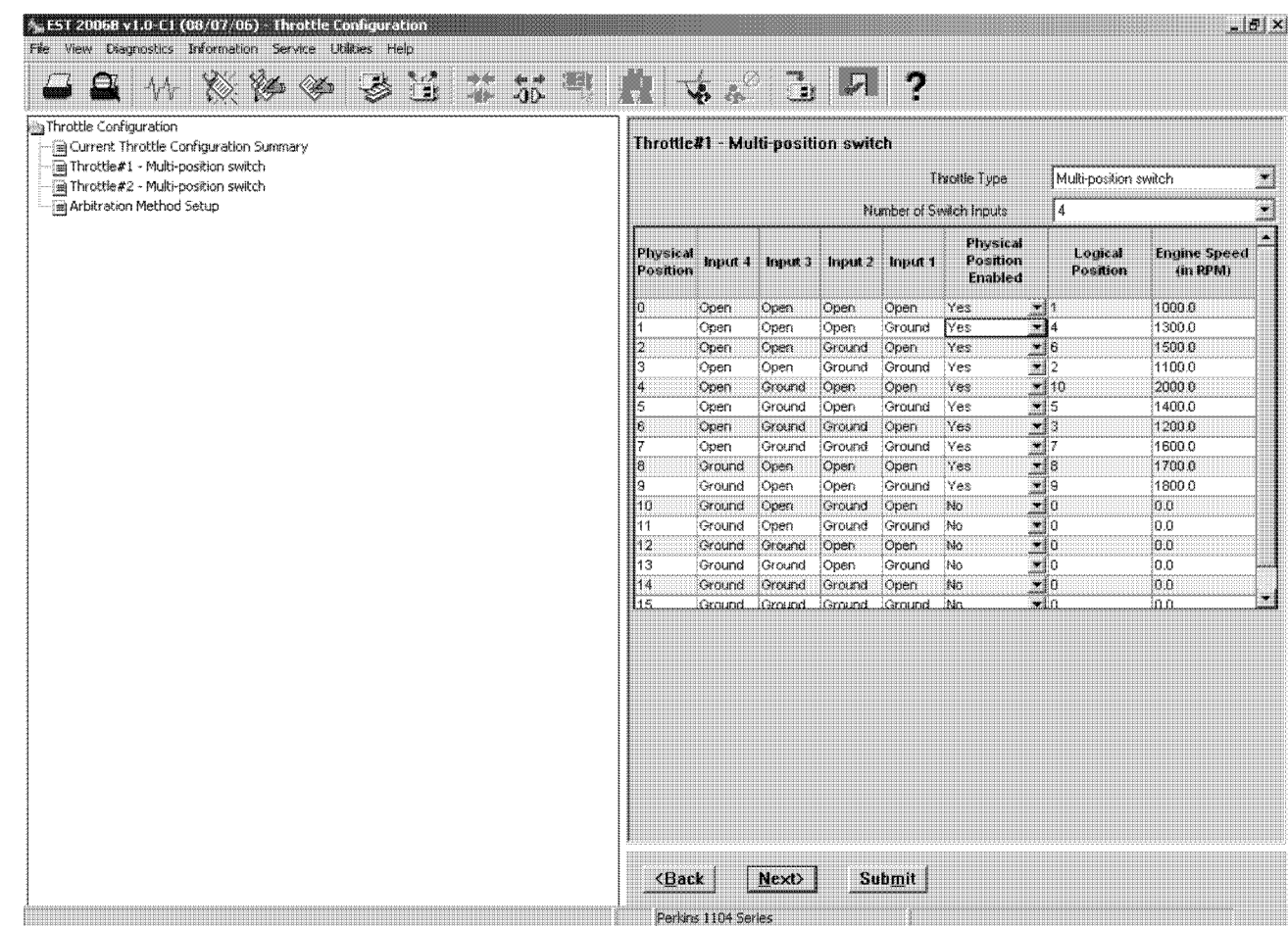


Illustration 124
g01322535

Test Step 1. Inspect Electrical Connectors and Wiring

A. Turn the keyswitch to the OFF position.

B. Thoroughly inspect ECM connector J1/P1, machine interface connector J20/P20, and the battery connections. Refer to Troubleshooting, “Electrical Connectors - Inspect” for details.

- C. Check the harness and wiring for corrosion, abrasion, and pinch points from the throttle switch to the ECM.

Expected Result:

All connectors, pins, and sockets should be completely inserted and coupled. The harness and wiring should be free of corrosion, abrasion, and pinch points.

Results:

- OK – Proceed to Test Step 2.
- Not OK

Repair: Repair the circuit.

Verify that the repair eliminates the fault.

STOP.

Test Step 2. Check “Throttle Switch Position” on the Electronic Service Tool

- A. Turn the keyswitch to the OFF position.
- B. Connect the electronic service tool to the diagnostic connector.
- C. Turn the keyswitch to the ON position.
- D. Observe the status of the throttle switch and the throttle inputs on the electronic service tool while you operate the throttle switch in each position.

Expected Result:

The status on the electronic service tool should correspond with the information that is displayed on the “Throttle Configuration Screen” on the electronic service tool. For an example, refer to Illustration 124.

Results:

- OK – The throttle switch is functioning correctly.

Repair: Refer to Troubleshooting, “Electrical Connectors - Inspect” if the fault is intermittent.

STOP.

- Not OK – Record the suspect input. Proceed to Test Step 3.

Test Step 3. Jumper the Switch Input at the Suspect Throttle Position Switch

- A. Turn the keyswitch to the OFF position.
- B. Observe the status of the suspect throttle input on the electronic service tool.

- C. On applications with a 31 pin MIC, use a suitable jumper wire to short P20:28 Switch Return to the terminal for the suspect throttle input on the P20 connector.

- D. On applications with a 70 pin MIC, use a suitable jumper wire to short P20:37 Switch Return to the terminal for the suspect throttle input on the P20 connector.

- E. Observe the status of the suspect throttle input on the electronic service tool.

- F. Remove the wire short.

Expected Result:

The status of the suspect throttle input should be “OFF” when the jumper wire is disconnected. The status should be “ON” when the jumper wire is connected.

Results:

- OK – The engine harness and the ECM are OK.

Repair: Repair the machine wiring or replace the machine wiring or the suspect throttle switch. Refer to the documentation for the application.

Verify that the repair eliminates the fault.

STOP.

- Not OK – Proceed to Test Step 4.

Test Step 4. Check for Shorts in the Harness

- A. Turn the keyswitch to the OFF position.

- B. Disconnect the J1/P1 ECM connector.

- C. Disconnect the J20/P20 MIC connector.

- D. On applications with a 31 pin MIC, measure the resistance between the following pairs of pins:

- P1:11 and P20:24 Throttle Switch No.3
- P1:19 and P20:22 Throttle Switch No.4
- P1:20 and P20:25 Throttle Switch No.2
- P1:28 and P20:21 Throttle Switch No.1
- P1:37 and P20:28 Switch Return

- E. On applications with a 70 pin MIC, measure the resistance between the following pairs of pins:

- P1:11 and P20:11 Throttle Switch No.3

- P1:19 and P20:19 Throttle Switch No.4
- P1:20 and P20:20 Throttle Switch No.2
- P1:28 and P20:28 Throttle Switch No.1
- P1:37 and P20:37 Switch Return

Expected Result:

The measured resistance should be less than 10 ohms.

Results:

- OK – Proceed to Test Step 5.
- Not OK – There is a fault in a wire between the P1 connector and the P20 connector.

Repair: Repair the circuit.

Verify that the repair eliminates the fault.

STOP.

Test Step 5. Test the Engine ECM

- A.** Turn the keyswitch to the OFF position.
- B.** Insert a 70 pin Breakout T between the P1 connector and J1 connector.
- C.** Insert one end of a jumper wire into the socket for the suspect switch. Insert the other end of the jumper wire into P1:37 switch return.
- D.** Turn the keyswitch to the ON position and monitor the status screen on the electronic service tool. Slowly connect and disconnect the jumper wire from the socket of pin 37 of the Breakout T.

Expected Result:

The status screen should display an OPEN condition with the switch in the OFF position.

The status screen should display a CLOSED condition with the switch in the ON position.

Results:

- OK – The ECM is working correctly. STOP.
- Not OK – The ECM is not working correctly.

Repair: Temporarily connect a test ECM.

The test ECM should be programmed with the correct software. All parameters should be set to the same values as the suspect ECM.

If the fault is eliminated with the test ECM, reconnect the suspect ECM.

If the fault returns with the suspect ECM, then the suspect ECM is faulty.

Replace the suspect ECM.

Verify that the repair has eliminated the fault.

STOP.

Index

Numerics

5 Volt Engine Pressure Sensor Supply Circuit - Test	89
---	----

A

Air Inlet Heater Circuit - Test.....	93
Alternator Noise (Noisy Operation).....	34
Probable Causes	34
Recommended Actions.....	34
Alternator Will Not Charge (Charging Problem)	34
Probable Causes	34
Recommended Actions.....	34
Analog Throttle Position Sensor Circuit - Test.....	98

B

Battery	35
Probable Causes	35
Recommended Actions.....	35

C

CAN Data Link Circuit - Test.....	103
Can Not Reach Top Engine RPM.....	35
Probable Causes	35
Recommended Actions.....	35
CID 0041 FMI 03	62
CID 0041 FMI 04	63
CID 0091 FMI 02	63
CID 0091 FMI 03	64
CID 0091 FMI 04	64
CID 0091 FMI 08	65
CID 0091 FMI 12	65
CID 0100 FMI 03	66
CID 0100 FMI 04	66
CID 0100 FMI 10	66
CID 0102 FMI 03	67
CID 0102 FMI 04	67
CID 0102 FMI 10	68
CID 0105 FMI 03	68
CID 0105 FMI 04	68
CID 0110 FMI 03	69
CID 0110 FMI 04	69
CID 0174 FMI 02	69
CID 0247 FMI 09	70
CID 0253 FMI 02	70
CID 0262 FMI 03	70
CID 0262 FMI 04	71
CID 0320 FMI 02	71
CID 0320 FMI 11	71
CID 0342 FMI 02	72
CID 0774 FMI 02	72
CID 0774 FMI 03	73
CID 0774 FMI 04	73
CID 0774 FMI 08	74

CID 0774 FMI 12	74
CID 1627 FMI 03	75
CID 1684 FMI 00	75
CID 1684 FMI 02	76
CID 1684 FMI 03	76
CID 1684 FMI 04	77
CID 1684 FMI 05	77
CID 1684 FMI 07	77
CID 1684 FMI 08	78
CID 1684 FMI 09	78
CID 1684 FMI 10	79
CID 1684 FMI 11	80
CID 1684 FMI 12	80
CID 1684 FMI 14	81
CID 1743 FMI 02	81
CID 1894 FMI 02	82
CID 1895 FMI 02	82
Coolant in Engine Oil.....	36
Probable Causes	36
Recommended Actions.....	36
Coolant Temperature Is Too High.....	37
Probable Causes	37
Recommended Actions.....	37

D

Data Link Circuit - Test	111
Diagnostic Code Cross Reference	61
Diagnostic Functional Tests.....	89
Digital Throttle Position Sensor Circuit - Test	119

E

E015 High Engine Coolant Temperature Derate ...	83
E016 High Engine Coolant Temperature Shutdown.....	83
E017 High Engine Coolant Temperature Warning..	83
E025 High Inlet Air Temperature Derate.....	84
E027 High Inlet Air Temperature Warning	84
E040 Low Engine Oil Pressure Shutdown.....	85
E054 High Fuel Temperature Derate.....	85
E056 High Fuel Temperature Warning	86
E100 Low Engine Oil Pressure Warning	87
E190 Engine Overspeed Warning	88
ECM Will Not Accept Factory Passwords.....	38
Probable Causes	38
Recommended Actions.....	38
ECM Will Not Communicate with Other Systems or Display Modules	39
Probable Causes	39
Recommended Actions.....	39
Electrical Connectors - Inspect.....	125
Electrical Power Supply Circuit - Test.....	134
Electronic Service Tool Will Not Communicate with ECM.....	39
Probable Causes	39
Recommended Actions.....	39

Electronic Service Tools	12
Optional Service Tools	12
Perkins Electronic Service Tool.....	12
Required Service Tools	12
Electronic Troubleshooting	5
Engine Cranks but Will Not Start	40
Probable Causes	40
Recommended Actions	40
Engine Has Early Wear	42
Probable Causes	42
Recommended Actions	42
Engine Misfires, Runs Rough or Is Unstable.....	42
Probable Causes	43
Recommended Actions	43
Engine Oil in Cooling System	44
Probable Causes	44
Recommended Actions	45
Engine Pressure Sensor Open or Short Circuit - Test	139
Engine Stalls at Low RPM	45
Probable Causes	45
Recommended Actions	45
Engine Temperature Sensor Open or Short Circuit - Test	145
Engine Vibration	46
Probable Causes	46
Recommended Actions	46
Engine Will Not Crank	47
Probable Causes	47
Recommended Repairs	47
Engine Wiring Information	22
Harness Wire Identification	24
Machine Interface Connector	25
Event Codes	83
Programmable Engine Parameters.....	83
Excessive Black Smoke	48
Probable Causes	48
Recommended Actions	48
Excessive Engine Oil Consumption.....	49
Probable Causes	49
Recommended Actions	49
Excessive Valve Lash	51
Probable Causes	51
Recommended Actions	51
Excessive White Smoke	51
Probable Causes	51
Recommended Actions	51

F

Factory Passwords	31
Factory Passwords	31
Passwords	31
Flash Programming	31
Flash Programming a Flash File	31
Fuel Injection Pump Circuit - Test.....	149

G

Glossary	9
----------------	---

I

Important Safety Information	2
Indicator Lamp Circuit - Test.....	159
Indicator Lamps	14
Use the lamps to check the operational status of the engine or the existence of any engine faults.....	14
Use the lamps to identify active diagnostic codes.....	15
Intake Air Temperature Is Too High	52
Probable Causes	52
Recommended Repairs	52
Intermittent Engine Shutdown	53
Probable Causes	53
Recommended Actions	53
Intermittent Low Power or Power Cutout.....	54
Probable Causes	54
Recommended Repairs	54

L

Low Engine Oil Pressure	56
Probable Causes	56
Recommended Actions	56
Low Power/Poor or No Response to Throttle	57
Probable Causes	57
Recommended Actions	57

M

Mechanical Noise (Knock) in Engine.....	59
Probable Causes	59
Recommended Actions	59
Mode Selection Circuit - Test.....	162

N

Noise Coming from Cylinder.....	60
Probable Causes	60
Recommended Actions	60

P

Programming Parameters	31
------------------------------	----

R

Replacing the ECM.....	16
Replacement of the ECM.....	16
Using a Test ECM	16

S

Self-Diagnostics.....	17
Sensors and Electrical Connectors	18
Set Speed Circuit - Test.....	166

Speed/Timing Sensor Circuit - Test	171
System Configuration Parameters.....	33
“ECM Software Release Date”	33
“Engine Serial Number”	33
“Full Load Setting”	33
“Full Torque Setting”	33
Rating Interlock.....	33
System Overview.....	5
Diagnostic Codes	8
Passwords	8
Programmable Parameters.....	8
System Operation	5

T

Table of Contents.....	3
Throttle Switch Circuit - Test.....	174
Troubleshooting Section.....	5
Troubleshooting with a Diagnostic Code	61
Troubleshooting with an Event Code.....	83
Troubleshooting without a Diagnostic Code	34

